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No. 2,661.] *FRIDAY, NOVEMBER 20, 1903.* *[Vol. LII.*

ONE-HUNDRED-AND-FIFTIETH SESSION, 1903-1904.

PATRON—HIS MOST GRACIOUS MAJESTY THE KING.

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Assistant Secretary for the Indian and Colonial Sections.—SAMUEL DIGBY.

Chief Clerk.—GEORGE DAVENPORT. *Accountant.*—J. H. BUCHANAN. *Auditors.*—KNOX, CROPPER & CO.

SESSIONAL ARRANGEMENTS.

The Opening Meeting of the One-hundred-and-Fiftieth Session was held on Wednesday Evening, the 18th of November, when an Address was delivered by Sir WILLIAM ABNEY, K.C.B., D.C.L., D.Sc., F.R.S., Vice-President and Chairman of the Council.

For meetings previous to Christmas the following arrangements have been made :—

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock :—

NOVEMBER 25.—GEORGE F. PARKER, "The Universal Exposition at St. Louis, U.S.A., 1904."

DECEMBER 2.—SIR CHARLES MALCOLM KENNEDY, K.C.M.G., C.B., "Fiscal Problem." SIR GEORGE BIRDWOOD, K.C.I.E., C.S.I., will preside.

" 9.—HENRY HARDINGE CUNYNGHAME, C.B., "Furnaces suitable for Jewellers' Work, Enamelling, Art Casting, and other similar Industries." PROFESSOR CHARLES VERNON BOYS, F.R.S., will preside.

" 16.—SIR WILLIAM HENRY PREECE, K.C.B., F.R.S., "The Science of Taxation and Business." SIR ROBERT GIFFEN, K.C.B., LL.D., F.R.S., will preside.

For Meetings after Christmas:—

ARTHUR GULSTON, "Ice Breakers and their Services."

EDWIN O. SACHS, "Lessons to be Learnt from the Fire Brigade Appliances at the late International Fire Exhibition."

THOMAS CASSON, "Organ Design."

FRANK TIFFANY, "Mahogany and other Fancy Woods available for Constructive and Decorative Purposes."

L. P. FORD, "Artificial and other Building Stones."

PROF. CHARLES VERNON BOYS, F.R.S., "Thermit."

THOMAS CLARKSON, M.I.Mech.E., "Steam Motors."

RICHARD R. HOLMES, C.V.O., "Early Painting in Miniature."

J. W. COWARD, "Mechanical Piano Players."

SIR WILLIAM LEE-WARNER, K.C.S.I., "The Presidency of Bombay."

ALFRED R. SENNETT, Assoc.M.Inst.C.E., M.I.E.E., "Garden Cities in their relation to Industries and Agriculture."

J. C. MEDD, "Agricultural Education."

INDIAN SECTION.

Thursday Afternoons, at 4.30 o'clock:—

December 10, January 21, February 11, March 10, April 28, May 12.

DECEMBER 10.—J. M. MACLEAN, "India's Place in an Imperial Federation." SIR EDWARD A. SASSOON, Bart., M.P., will preside.

COLONIAL SECTION.

Tuesday Afternoons, at 4.30 o'clock:—

February 2, March 1, April 12, May 3.

APPLIED ART SECTION.

Tuesdays, at 4.30 or 8 o'clock:—

December 15, January 19, February 16, March 15, April 19, May 17.

DECEMBER 15, at 8 o'clock.—FRANK WARNER, "The British Silk Industry." SIR THOMAS WARDLE will preside.

CANTOR LECTURES.

Monday Evenings, at 8 o'clock:—

BENNETT H. BROUGH, "The Mining of Non-Metallic Minerals." Four Lectures.

LECTURE I.—NOVEMBER 23.—*Coals and Bitumens.*—Graphite—Coal—Brown coal—Peat—Petroleum—Ozokerite—Asphalt.

LECTURE II.—NOVEMBER 30.—*Salts.*—Rocksalt—Potash salts—Borates—Alums—Nitrates—Phosphates.

LECTURE III.—DECEMBER 7.—*Stone.*—Flint, Sandstone—Limestone—Marble—Dolomite—Slate—Eruptive rocks Mica—Clays—Gypsum—Asbestos—Bauxite—Other earthy minerals.

LECTURE IV.—DECEMBER 14.—*Precious Stones.*—Diamond—Corundum gems—Emerald—Other precious stones—Ornamental stones—Rare earths.

J. LEWKOWITSCH, Ph.D., M.A., F.I.C., "Oils and Fats—their Uses and Applications." Four Lectures.

January 25, February 1, 8, 15.

CHARLES T. JACOBI, "Modern Book Printing." Two Lectures.
February 22, 29.

BERTRAM BLOUNT, F.I.C., "Recent Advances in Electro-Chemistry." Three Lectures.
March 7, 14, 21.

Monday Afternoons, at 4.30 o'clock:—

PROFESSOR R. LANGTON DOUGLAS, M.A., "The Majolica and Glazed Earthenware of Tuscany." Three Lectures.
April 25, May 2, 9.

JUVENILE LECTURES.

Wednesday Evenings, January 6 and 13, 1904, at 5 o'clock.

ERIC STUART BRUCE, M.A., "Navigation of the Air."

CONVERSAZIONE.

The Annual Conversazione of the Society will probably be held on Thursday, June 30, 1904. Each member is entitled to a card for himself, and one for a lady.

PROCEEDINGS OF THE SOCIETY.

CHARTER.—THE SOCIETY OF ARTS was founded in 1754, and incorporated by Royal Charter in 1847, for "The Encouragement of the Arts, Manufactures, and Commerce of the Country, by bestowing rewards for such productions, inventions, or improvements as tend to the employment of the poor, to the increase of trade, and to the riches and honour of the kingdom; and for meritorious works in the various departments of the Fine Arts; for Discoveries, Inventions, and Improvements in Agriculture, Chemistry, Mechanics, Manufactures, and other useful Arts; for the application of such natural and artificial products, whether of Home, Colonial, or Foreign growth and manufacture, as may appear likely to afford fresh objects of industry, and to increase the trade of the realm by extending the sphere of British commerce; and generally to assist in the advancement, development, and practical application of every department or science in connection with the Arts, Manufactures, and Commerce of this country."

THE SESSION.—The Session commences in November, and ends in June.

ORDINARY MEETINGS.—At the Wednesday Evening Meetings during the Session, papers on subjects relating to inventions, improvements, discoveries, and other matters connected with the Arts, Manufactures, and Commerce of the country are read and discussed.

INDIAN SECTION.—This Section was established in 1869, for the discussion of subjects connected with our Indian Empire. Six or more Meetings are held during the Session.

COLONIAL SECTION.—The Section was formed in 1874 under the title of the African Section, for the discussion of subjects connected with the Continent of Africa. It was enlarged in 1879, so as to include the consideration of subjects connected with our Colonies and Dependencies. Four or more Meetings are held during the Session.

APPLIED ART SECTION.—This Section was formed in 1886, for the discussion of subjects connected with the industrial applications of the Fine Arts. Six or more Meetings are held during the Session.

Cantor Lectures.—These Lectures originated in 1863, with a bequest by the late Dr. Cantor. There are several Courses every Session, and each course consists generally of two or more Lectures.

Additional Lectures.—Special Courses of Lectures are occasionally given.

Juvenile Lectures.—A Short Course of Lectures, suited for a Juvenile audience, is delivered to the Children of Members during the Christmas Holidays.

Admission to Meetings.—Members have the right of attending the above Meetings and Lectures. They require no tickets, but are admitted by signing their names. Every Member can admit *two* friends to the Ordinary and Sectional Meetings, and *one* friend to the Cantor and other Lectures. Books of tickets for the purpose are supplied to the Members, but admission can be obtained on the personal introduction of a Member. For the Juvenile Lectures special tickets are issued.

Journal of the Society of Arts.—The *Journal*, which is sent free to Members, is published weekly, and contains full Reports of all the Society's Proceedings, as well as a variety of information connected with Arts, Manufactures, and Commerce.

Examinations.—Examinations, founded in 1853, are held annually by the Society, through the agency of Local Committees, at various centres in the country. They are open to any person. The subjects include the principal divisions of a Commercial Education, and Music. A Programme, containing detailed information about the Examinations, can be had on application to the Secretary.

Library and Reading-room.—The Library and Reading-room are open to Members, who are also entitled to borrow books.

Conversazioni are held, to which Members are invited, each Member receiving a card for himself and a lady.

MEMBERSHIP.

The Society numbers at present between three and four thousand Members. The Annual Subscription is Two Guineas, payable in advance, and dates from the quarter-day preceding election; or a Life Subscription of Twenty Guineas may be paid. There is no Entrance Fee.

Every Member whose subscription is not in arrear is entitled:—

- To be present at the Evening Meetings of the Society, and to introduce two visitors at such meetings, subject to such special arrangements as the Council may deem necessary to be made from time to time.
- To be present and vote at all General Meetings of the Society.
- To be present at the Cantor and other Lectures, and to introduce one visitor.
- To have personal free admission to all Exhibitions held by the Society at its house in the Adelphi.
- To be present at all the Society's *Conversazioni.*
- To receive a copy of the weekly *Journal* published by the Society.
- To the use of the Library and Reading-room.

Candidates for Membership are proposed by Three Members, one of whom, at least, must sign on personal knowledge; or are nominated by the Council.

All subscriptions should be paid to the Secretary, Sir Henry Trueman Wood, and all Cheques or Post-office Orders should be crossed "Coutts and Company," and forwarded to him at the Society's House, John-street, Adelphi, London, W.C.

HENRY TRUEMAN WOOD, *Secretary*

CALENDAR FOR THE SESSION.

The following is the Calendar for the Session 1903-1904. It is issued subject to any necessary alterations:—

NOVEMBER, 1903.

1	**S**	
2	M	
3	Tu	
4	W	
5	Th	
6	F	
7	S	
8	**S**	
9	M	
10	Tu	
11	W	
12	Th	
13	F	
14	S	
15	**S**	
16	M	
17	Tu	
18	W	Opening Meeting of
19	Th	the Session
20	F	
21	S	
22	**S**	
23	M	Cantor Lecture I. 1
24	Tu	
25	W	Ordinary Meeting
26	Th	
27	F	
28	S	
29	**S**	
30	M	Cantor Lecture I. 2

DECEMBER, 1903.

1	Tu	
2	W	Ordinary Meeting
3	Th	
4	F	
5	S	
6	**S**	
7	M	Cantor Lecture I. 3
8	Tu	
9	W	Ordinary Meeting
10	Th	Indian Section
11	F	
12	S	
13	**S**	
14	M	Cantor Lecture I. 4
15	Tu	Applied Art Section
16	W	Ordinary Meeting
17	Th	
18	F	
19	S	
20	**S**	
21	M	
22	Tu	
23	W	
24	Th	
25	F	CHRISTMAS DAY
26	S	*Bank Holiday*
27	**S**	
28	M	
29	Tu	
30	W	
31	Th	

JANUARY, 1904.

1	F	
2	S	
3	**S**	
4	M	
5	Tu	
6	W	Juvenile Lecture I.
7	Th	
8	F	
9	S	
10	**S**	
11	M	
12	Tu	
13	W	Juvenile Lecture II.
14	Th	
15	F	
16	S	
17	**S**	
18	M	
19	Tu	Applied Art Section
20	W	Ordinary Meeting
21	Th	Indian Section
22	F	
23	S	
24	**S**	
25	M	Cantor Lecture II. 1
26	Tu	
27	W	Ordinary Meeting
28	Th	
29	F	
30	S	
31	**S**	

FEBRUARY, 1904.

1	M	Cantor Lecture II. 2
2	Tu	Colonial Section
3	W	Ordinary Meeting
4	Th	
5	F	
6	S	
7	**S**	
8	M	Cantor Lecture II. 3
9	Tu	
10	W	Ordinary Meeting
11	Th	Indian Section
12	F	
13	S	
14	**S**	
15	M	Cantor Lecture II. 4
16	Tu	Applied Art Section
17	W	Ordinary Meeting
18	Th	
19	F	
20	S	
21	**S**	
22	M	Cantor Lecture III. 1
23	Tu	
24	W	Ordinary Meeting
25	Th	
26	F	
27	S	
28	**S**	
29	M	Cantor Lecture III. 2

MARCH, 1904.

1	Tu	Colonial Section
2	W	Ordinary Meeting
3	Th	
4	F	
5	S	
6	**S**	
7	M	Cantor Lecture IV. 1
8	Tu	
9	W	Ordinary Meeting
10	Th	Indian Section
11	F	
12	S	
13	**S**	
14	M	Cantor Lecture IV. 2
15	Tu	Applied Art Section
16	W	Ordinary Meeting
17	Th	
18	F	
19	S	
20	**S**	
21	M	Cantor Lecture IV. 3
22	Tu	
23	W	Ordinary Meeting
24	Th	
25	F	
26	S	
27	**S**	
28	M	
29	Tu	
30	W	
31	Th	

APRIL, 1904.

1	F	GOOD FRIDAY
2	S	
3	**S**	EASTER SUNDAY
4	M	*Bank Holiday*
5	Tu	
6	W	
7	Th	
8	F	
9	S	
10	**S**	
11	M	
12	Tu	Colonial Section
13	W	Ordinary Meeting
14	Th	
15	F	
16	S	
17	**S**	
18	M	
19	Tu	Applied Art Section
20	W	Ordinary Meeting
21	Th	
22	F	
23	S	
24	**S**	
25	M	Cantor Lecture V. 1
26	Tu	
27	W	Ordinary Meeting
28	Th	Indian Section
29	F	
30	S	

MAY, 1904.

1	**S**	
2	M	Cantor Lecture V. 2
3	Tu	Colonial Section
4	W	Ordinary Meeting
5	Th	
6	F	
7	S	
8	**S**	
9	M	Cantor Lecture V. 3
10	Tu	
11	W	Ordinary Meeting
12	Th	Indian Section
13	F	
14	S	
15	**S**	
16	M	
17	Tu	Applied Art Section
18	W	Ordinary Meeting
19	Th	
20	F	
21	S	
22	**S**	WHIT SUNDAY
23	M	*Bank Holiday*
24	Tu	
25	W	
26	Th	
27	F	
28	S	
29	**S**	
30	M	
31	Tu	

JUNE, 1904.

1	W	
2	Th	
3	F	
4	S	
5	**S**	
6	M	
7	Tu	
8	W	
9	Th	
10	F	
11	S	
12	**S**	
13	M	
14	Tu	
15	W	
16	Th	
17	F	
18	S	
19	**S**	
20	M	
21	Tu	
22	W	
23	Th	
24	F	
25	S	
26	**S**	
27	M	
28	Tu	
29	W	Annual General Meeting
30	Th	*Conversazione*

The Cantor Lectures will commence at Half-past Four or Eight o'clock.

The Ordinary Meetings will commence at Eight o'clock.

The Meetings of the Indian Section and the Colonial Section will commence at Half-past Four o'clock.

The Meetings of the Applied Art Section will be held at Half-past Four or Eight o'clock.

The Annual General Meeting will be held at Four o'clock.

The Juvenile Lectures will be given at Five o'clock.

Notices.

APPLIED ART SECTION COMMITTEE.

A meeting of the Committee of the Applied Art Section was held on Tuesday afternoon, 17th inst. Present: Sir George Birdwood, K.C.I.E., C.S.I., LL.D., M.D., in the chair; Sir Caspar Purdon Clarke, C.I.E., Cyril Davenport, F.S.A., Lewis Foreman Day, William Gowland, F.S.A., Gerald C. Horsley, Arthur Lasenby Liberty, Sir Walter S. Prideaux, Halsey Ralph Ricardo, John Sparkes, H. H. Statham, F.R.I.B.A., Carmichael Thomas, Sir John I. Thornycroft, LL.D., F.R.S., with Henry B. Wheatley, Secretary of the Section.

The arrangements for the new Session were considered.

CANTOR LECTURES ON PAPER MANUFACTURE.

Mr. JULIUS HÜBNER'S Cantor Lectures on "Paper Manufacture" have been reprinted from the *Journal*, and the pamphlet (price one shilling) can be obtained on application to the Secretary, Society of Arts, John-street, Adelphi, W.C. A full list of the Cantor Lectures which have been published separately and are still on sale can be obtained on application to the Secretary.

Proceedings of the Society.

FIRST ORDINARY MEETING.

Wednesday, November 20, 1903; SIR WILLIAM ABNEY, K.C.B., D.C.L., D.Sc., F.R.S., Chairman of the Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Adcock, Cecil Philip, Via Marco Minghetti, Galleria Sciarra, Rome, Italy.
Allbless, Edalji Dossabhoy, 4c, Patel-street, Fort, Bombay, India.
Allen, Raymond Cecil, Chief Surveyor, Uganda, British East Africa.
Anaman, Rev. Jacob Benjamin, Anamaboe, Gold Coast, West Africa.
Anderson, Ralph W., Government Offices, Bloemfontein, Orange River Colony, South Africa.
André, Eugene, Trinidad Union Club, Trinidad, British West Indies.
Archer, William Henry, New Gas Works, Cromer.
Ashpitel, Francis Wm., Assoc.M.Inst.C.E., Eastfield-lodge, Guildford.
Baker, Thomas Summers, Hong Kong and Shanghai Bank, Yokohama, Japan.
Bakewell, William Whitehorn, Dilwyn, Manor-road, St. Alban's.
Barham, Charles James, The Elms, Erith.
Bass, John Foster, LL.B., 189, La Salle-street, Chicago, Ill., U.S.A.
Baumann, Paul A., Kenmore, The Bishop's-avenue, Hampstead-lane, N.
Bayldon, Edward Herbert, J.P., Oaklands, Dawlish, Devon.
Beatty, John W., M.A., Carnegie Institute, Pittsburgh, Pennsylvania, U.S.A.
Beaumont, Eugene C., 78, Fleet-street, E.C.
Bentley, Mrs. Royds, Lochcote, Linlithgow, N.B., and West Bilney Hall, King's Lynn.
Bevan, Charles Lewis Huzzard, 19, Bouverie-road West, Folkestone.
Blagden, Arthur H., A.M.I.E.E., Electricity Department, Municipal Council, Shanghai, China.
Botwood, Charles Walker, D.Sc., Ph.D., 74, Micklegate, York.
Bower, Tom H. V., M.Am.I.M.E., 6, Salisbury-house, London-wall, E.C.
Bradburn, Albert Edwin, 19, King Edward-street, Macclesfield.
Bradford, Frank, A.M.I.E.E., 17, Denman-drive, Newsham-park, Liverpool.
Bradford, Henry, 51, Welbeck-street, W.
Bradley-Birt, Francis Bradley, Gobindpur, Manbhum, Chota Nagpore, India.
Britton, Sydney E., A.M.I.E.E., A.M.I.Mech.E., Electricity Works, Motherwell, N.B.
Broom, George Henry, the Technical College, Huddersfield.
Brown, James Clifford, 20, Lewin-road, Streatham-common, S.W.
Brown, John Armour, Moredun, Paisley, N.B.
Calvert, Edward, Electricity Works, Squires'-lane, Finchley, N.
Carpenter, Henry Cort Harold, the National Physical Laboratory, Bushey-house, Teddington.
Carter, Alfred, Sanitary Board Offices, Hong Kong.
Cates, Mrs. Arthur, 12, York-terrace, Regent's park, N.W.
Chesher, Rev. Ernest William, 8, St. Alban's-road, Swansea.
Chinoy, Phirozshaw Ardeshir, 9, Hornby-row, Fort, Bombay, India.
Christian, Edward A., 12, The Woodlands, Clifton-park, Birkenhead.
Clulow, George, 51, Belsize-avenue, N.W.
Cofman-Nicoresti, J., 41, Hart-street, W.C.

Converse, C. Crozat, LL.D., Highwood, Bergen County, New Jersey, U.S.A.
Cowan, Lieut.-Col. James Henry, R.E., Roxburgh, Vanbrugh Park-road west, Blackheath, S.E.
Cowan, Percy John, A.M.I.Mech.E., 10, Buckingham-street, Strand, W.C.
Coyle, Daniel, M.I.E.E., 63, Warwick-street, Belgrave road, S.W.
Craddock, Arthur R., A.I.E.E., Canterbury College, Christchurch, New Zealand.
Crittall, Richard, 27, Noel-street, Wardour-street, W.
Cullen, Percy, Fort Johnston, British Central Africa.
Cushing, Rev. J. N., Baptist College, Rangoon, Burma.
Darlington, Latimer, D.C.L., Consul de Belgique, Bradford.
Davies, George Thomas, A.M.I.E.E., 10, Sion-hill, Clifton, Bristol.
De Carteret, Captain William George Squares, P.O. Box 456, Halifax, Nova Scotia, and The Pines, Beer, near Seaton, Devonshire.
Deerr, Noël, Beau Champ G.R.S.E., Mauritius.
Defries, Miss Violet, 18, Elgin-crescent, Notting hill, W.
Deutschberger, Rev. S. J., B.A., 266, Dalston-lane, Lower Clapton, N.E.
Dobson, William Henry, Standerton Heath Board, P.O. Box 66, Standerton, Transvaal, South Africa.
Donnithorne, Harold Edward, A.M.I.E.E., 76, Queen's-gate, S.W.
Du Bois, Patterson, care of Frau Dr. Harrass, Laves Strasse 73I, Hannover, Germany.
Dunbar-Anderson, Kingsley, M.I M.E., M.I. Mech E., The Bungalow, Pretoria-street, Hospital-hill, Johannesburg, South Africa.
Dwyer, Feargus, The Residency, Kontagora, Northern Nigeria, West Africa.
Eckersley, James, 80, Gloucester-place, Portman-square, W.
Edwards, Walter Moorcroft, Luipaardsvlei, Krugersdorp, Transvaal, South Africa.
Ermen, George, A.M.I.Mech.E., Messrs. George Wragge, Ltd., 152–156, Chapel-street, Salford, Manchester.
Fairweather, Wallace Cranston, M.A., 65 and 66, Chancery-lane, W.C.
Faulkner, Arthur, The Gables, St. Peter's-park, St. Alban's, Herts.
Fenning, Edward George, 5, Briarwood-road, Clapham, S.W.
Fitzwilliam, Leo D., Edward-street, Princes-town, Trinidad, British West Indies.
Fowler, Thomas Benjamin Davis, 441, Bartolomé Mitre, Buenos Aires, South America.
Fraser, S. E., Waikino, Waihi, New Zealand.
Garnett, Herbert, A.M.I.Mech.E., Maghery, Moy, Co. Tyrone.
Gerothwohl, Maurice Alfred, 94, Redcliffe-gardens, S.W.
Good, George Lacy, M.Inst.C.E., Cape Government Railways, Kri-road, Cape Colony, South Africa.
Gott, Alfred Thomas, 191, Horton-road, Bradford, Yorks.
Gradinger, E. C., Y.M.C.A. Buildings, Madras, India.
Grantham, Richard Fuge, M.Inst.C.E., 23, Northumberland-avenue, W.C.
Grey, W. H., Lagos, West Africa, and Junior Athenæum Club, W.
Griffiths, Manfred E., "Fernside," Stowmarket.
Gunner, Charles E., Mansion-house-chambers, 20, Bucklersbury, E.C.
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The CHAIRMAN delivered the following

ADDRESS.

We are now entering on the 150th year of the existence of the Society of Arts—for it was founded in 1754. At that date, only two learned or scientific societies were in being, viz., the Royal Society and the Society of Antiquaries, and from the nature of the times it has been called upon to occupy very varied spheres of usefulness. Before the Royal Academy was founded, it held exhibitions of pictures. It encouraged engineering and chemistry before the various special societies which now look after these subjects of science were established, and it promoted arts and industries in the Colonies more than a century before the Colonial or Imperial Institutes were established to fulfil this special purpose. As different societies sprung up in connection with the various subjects of natural knowledge, it became less necessary for this Society to foster them with the care that it had previously done, and it turned its attention to other kindred but unoccupied fields, and is doing so up to the present time. As it divested itself of one care, others, due to the progress of our race and times, have taken its place, and at present it has far-spreading bounds within which it has ample scope to expend its energy in benefiting the public. The varied programme which it issues indicates how wide are the boundaries of the field within which it works. It has been the establisher of International Exhibitions—on which blessings and the reverse have been showered by the commercial public, owing to their too oft recurrence—the work of the 1851 Exhibition having been carried out by it, till it handed it over to a Royal Commission, and it has taken an active part in the higher education of the country. To this latter subject I shall revert shortly. In reviewing the past and comparing it with the present, it is satisfactory to know that the Society stands higher than ever in the estimation of the public, as its numbers are larger this year than before, and last, but not least, its finances are in a more

satisfactory position than they ever have been, though it has never, I believe, had to struggle against deficits which some societies have had to war against.

I am sure that all here to-night will re-echo my wish that the Society may continue its useful work in the future with the same marked success that it has done in the past.

The question of remaining in our present house for long is somewhat uncertain. The original lease expired in 1897, when a further lease of seven years was granted, which expires next year, but the landlord has agreed to take us on year by year with two years notice, so that we may consider ourselves as occupants of these rooms for about another three years at least. The accommodation, however, is barely sufficient for our present immediate needs. It is especially deficient in library accommodation. It is the opinion of those who are conversant with the management of the Society, that if we had more room we might increase our usefulness. The circumstance that our lease has expired when our necessities for space have become greater, may be the means of enlarging our borders. One of the pieces of work for which room can scarcely be found is our examination work, and the mention of that work brings me back to the educational work which the Society has performed and is performing. I will only give a very brief history of what it has done in this direction.

In 1857 its first local examinations in various subjects of science and general education were instituted. In 1871 the Society added technological subjects to its syllabuses, and in 1876 a commercial certificate on the results of its examination was established. The examinations in technological subjects it handed at once bodily to the care of the City and Guilds of London Institute, but retained those which tested the instruction in commercial subjects.

They have been carried on ever since, with one slight interval, an interval that an interested public would not suffer to be prolonged.

The term of "Commercial Education" has become a very favourite expression, but it is one which it behoves us to use with some reserve, as it may mean a good deal more than it ought to do, and may be used in a sense which is more harmful than good. Whilst I was in the late Science and Art Department, the Ministers responsible for education had many memorials urging them to provide for the commercial education of this country; amongst others, one from the Associated Chambers of Commerce, which ran as follows:—

"That in the opinion of this Association it is desirable that young persons intended for commercial careers should, besides passing through the ordinary curriculum of a secondary school be specially instructed in subjects appertaining to commerce, and that in order to encourage the provision of such instruction and with a view to securing that the facilities for commercial education in the United Kingdom shall not be inferior to those of any continental country, it is urgently necessary that Government aid should be extended to the teaching of commercial subjects, as it now is to the teaching of science and art."

The wish expressed in the first part of this resolution is excellent, and cannot be too fully endorsed, since it inculcates that the ordinary curriculum of a secondary school should be carried out and should have superadded to it at some time or another the teaching of subjects appertaining to commerce. It is in exact conformity to the resolutions which have from time to time been passed at international conferences on Commercial Education, two of which I attended as an official delegate.

The resolution almost invites a statement as to the aid that the State is actually giving to commercial education. In the first place I propose to give some details which may help us to form an idea of the encouragement which it offers localities for the instruction of those who have left the day schools and who can be induced to attend evening classes. Their attendance is probably due to their having found out their deficiencies and having realised what will be of use to them in gaining advancement in the actual sphere of business in which they are employed. It has been largely lost sight of by many of those who think Government should take up the question of supplying Commercial Education that in the evening schools and classes, which are mainly supported by the Board of Education, no small sum of money, in the shape of grants, is annually paid for such instruction. Amongst the long lists of subjects which are aided, we find the following:—Commercial history and geography, commercial correspondence, modern languages, book-keeping, arithmetic, mercantile practice and law, shorthand, with typewriting, economics, and commercial English. It appears that some of these subjects are taken in a large number of the largest centres.

I have taken the curricula of 31 repre-

sentative places of instruction, and find that 21 take commercial correspondence, 30 book-keeping, 31 French, German, and shorthand, 11 commercial geography, 7 economics, 15 Spanish, 6 Italian, 2 Portuguese, 2 Russian, 1 Danish, 6 commercial arithmetic, 1 law for surveyors, and that substantial grants were paid to the schools in which they were taught. I must remind you that evening schools and classes have been opened in some 6,000 centres, and it is possible at each of these to earn grants for instruction in commercial subjects.

The grants are based on the attendances made by the students, and as it provided that the students must attend at least 14 lessons before they can earn a grant for the school, it may be supposed that all those students who do earn grants, must have received some benefit—small it may be—from the instruction. For every 20 attendances, the student earns a minimum of 2s. 6d. or a maximum of 5s., according to the efficiency of the instruction. The latter rate is, however, only payable when the instructor possesses high qualifications in the subject he teaches, and it is also limited to languages and some of the more difficult subjects.

As a student may make 160 paying attendances in all, it follows that the State may aid the instruction of each student between the limits of £1 and £2 per head: not a bad rate when it is considered that each hour counts as an attendance. The Board of Education inspects the classes and issues the rate of the grant on the report of the Inspector, but it does not hold examinations or grant certificates in these subjects. Here it is that we—the Society of Arts—step in. We hold the examinations, and it is not unfair to say that most of those who sit for them and endeavour to gain the Society's certificates come from the schools supported by the Board of Education. Out of the above 31 schools I find that at least 25 take our examinations and perhaps more. The rule in these evening classes is that no child under 12 or who is in attendance at any day school can be taught in them, but there is no superior age limit imposed. There have been cases where pupils of over 40 and 50, and even over 60, have earned attendance grants, and I believe some with such ages been successful candidates at these examinations.

Our examination returns indeed give one a good idea of the age at which a study of commercial subjects is most generally entered upon.

The annexed Table which has been compiled by the Society's staff shows the total number of students who were successful at the examinations of 1903, as also the number of those who were successful at the ages at 14, 15, and 16. It will be noted that those who succeed

EXAMINATIONS, 1903.

Grade I.

Subjects.	Total passes.	Passes at the age of 14.	Passes at the age of 15.	Passes at the age of 16.
Handwriting	163	13	40	23
Shorthand	1,106	73	137	206
Book-keeping	1,017	69	147	140
Arithmetic	369	53	63	56
Commercial History and Geography	34	4	6	5
French	397	21	36	51
German	192	10	19	8
Typewriting	398	18	56	79
Totals	3,676	261	504	568

Grade II.

Subjects.	Total passes.	Passes at the age of 14.	Passes at the age of 15.	Passes at the age of 16.
Arithmetic	227	7	18	40
English	196	27	21	20
Book-keeping	3,849	56	113	230
Commercial Geography	78	4	2	7
Shorthand	2,471	29	117	273
Typewriting	674	7	32	62
Economics	57	..	..	..
Précis-writing	63	..	..	3
French	619	1	13	32
German	270	..	4	11
Italian	10	..	..	..
Spanish	153	..	..	3
Portuguese	37	..	1	..
Russian	3	..	..	..
Danish	1	..	..	..
Totals	8,708	131	321	681

at 14 are fewer than those who succeed at 15, those at 15 fewer than those who succeed at 16, and that the percentage of the three ages together forms a small proportion of the total successes. The percentage of success of those who were examined at 14 years of age is 3·3; at 15 it is 6·6; at 16 it is 10·0, or at 14, 15, and 16 together 20 per cent. of the total. We may come to the conclusion that of those who study commercial subjects some 80 per cent. are 17 and over. I am informed that

the largest percentage is for students between 17 and 24. As 15 to 16 may be taken as the age at which boys leave ordinary secondary schools in which these examinations are not as a rule held, it indicates with some certainty that candidates below 16 are boys who have been educated at the public elementary schools, and who are therefore in subordinate positions in the business houses in which they are employed.

A further analysis of the Table is one of considerable interest besides that which it furnishes in regard to age. If we refer to the return of the Elementary Examination, Grade I., we see that the subjects most largely taken were shorthand and book-keeping, and if we add to the latter arithmetic, we find that no less than 68 per cent. of the whole of the successes were in these two subjects. These are the subjects above all which are required in the lower walks of business life. Languages come next with 16 per cent., and these are the subjects which are of use where the candidates are a grade higher in a business probably connected with foreign trade. As for commercial geography, which is only of direct use for the still higher grade, not 1 per cent. of the total successes is allotted to it. If we critically examine the successes in the higher examinations we shall find a similar state of things, and it points to the fact that, as the posts in a business house get higher in value, the number is a vastly diminishing one. It also indicates the possibilities which exist in advancement in home and foreign trade.

The above Table which Sir Henry Wood kindly caused to be got out for me is a most instructive one, and taken with the evening school returns of the Board of Education furnishes data of great value regarding the progress and possibilities of commercial education which exists in regard to adults who have not continued at school, but who have found it advisable to study further. I may add that if we study the technical side of the evening school curriculum we find that the students attending it are if not in a minority approaching thereto, and that the State is aiding commercial education as much as it aids the technical, except in the case of science and art, to which I shall immediately allude.

It appears then that so far as evening classes are concerned the demand for State aid has been fairly met, and it is only necessary for the localities to use such aid to meet their full requirements.

Now, it is often asserted that the aid to science and art in evening schools is far greater than that given to commercial subjects. So far as elementary science and drawing is concerned this is not the case. They are identically on the same footing. But where science has to be illustrated by experiments, incurring sometimes costly apparatus, and where practical science is taught which involves the provision not only of apparatus but of laboratories. there is no doubt that the aid is considerably higher. Now it is not to be supposed for one instant that any one wishes to level down the grants but to level up, and I, personally, should like to see a certain amount of levelling up. But it is only where the same precautions as to the qualifications of the teacher are taken, as are taken in the case of the more highly paid portions of science and art, that I wish to see increased payments made for instruction in commercial subjects, and then only for those subjects which demand high qualifications of the teachers. Languages, for instance, I should like to see more largely aided, but only where the teacher is a specialist in the subject. It would serve no useful purpose if the village schoolmaster, whose acquaintance with (say) French was extremely limited, was paid at a higher rate for giving instruction, but I should vote for increased remuneration where a professor of the language was employed, who could carry his pupils far beyond the home made teacher, and who could teach them not only to write but to speak French with a decent accent. The plan of paying by the attendance of students is perhaps the best that is at present possible. I have often thought over the subject, and devised schemes which would make the teacher less dependent for his remuneration on the number of pupils he had in his class. The most obvious plan is to pay the teacher so much a lesson, and make any increase depend on the size of his class, but there are great difficulties in any such plan, as some committees who govern the classes are quite equal to taking what I should call an unfair advantage of any regulation which might be manipulated to earn an undue grant. Most certainly the sizes of all classes ought be regulated, and instruction to overgrown numbers at one time must always be provided against. Under the present system of payment it is the small classes where the remuneration for instruction in insufficient, and a committee may reasonably refuse to start a small class for (say) commercial law, or Russian, if it cannot earn a fair amount towards its cost. It is these classes that suffer most, and I should be

glad to see some extra encouragement given to them.

As I have said before, the State is giving certainly a large amount of help towards instruction in commercial subjects, as taught in evening classes, but I should like to see more help given on the lines indicated above.

We may next consider the support direct and indirect that the State has given to any instruction in commercial subjects in any secondary schools. The resolution I have quoted asks that besides a good secondary instruction the pupils should have special instruction in commercial subjects. It is somewhat difficult to see exactly how that can be done without shortening to some extent the pupils' general education. Some very few years ago the London County Council took means, through its Technical Education Board, to ascertain the opinion of a number of typical employers of labour in London as to the value of commercial education. I cannot do better then quote from a paper written by our Secretary for the Venice Congress as to the conclusion at which the Committee arrived:—

"It is somewhat remarkable, considering the recent demand for commercial education on the part of employers, to find that the witnesses before the committee were practically unanimous in the opinion that for the lower grades of commercial employés special school training was undesirable. They all expressed their preference for a boy fresh from school, with the best elementary education, over the boy who would come a year or two later into the office after having passed the additional time in acquiring a probably imperfect knowledge of so-called commercial matters which probably would have no application in their special house of business. An intelligent boy, they said, coming into the office at 14, would at 16 be far more valuable to them from the special knowledge he had acquired, than a similar boy coming to the business at 16 with an imperfect equipment of so-called commercial education. It was urged that a few years later the boy who had had the more advanced instruction would then be the more useful of the two. This was admitted as possible, but, as a rule, the commercial experts seemed disinclined to allow even this much. They were, however, prepared to admit that boys, as a rule, left school much too early, and that it would be a great advantage if the school age could be extended for another year or two. But they were unanimously against early specialisation, and they one and all held to the point that, though it would undoubtedly be an advantage for boys to have another year or two's schooling, those years must be devoted to general education, not to instruction in commercial matters, or even to any attempt to acquire a knowledge of general business routine. It goes without saying that the education ought to be a modern one, and if classical languages were to be admitted, they were to have but a small part in it. Modern languages were important; book-keeping and shorthand should be included; and elementary mathematics were essential. All these subjects, too, should be taught with a view to their practical application—languages from a commercial, not a literary standpoint.

"On the question of higher commercial education, opinion was very much divided. The system of carrying on sham commercial transactions at school, which is strongly advocated by many Continental authorities and by some educational experts in England, met with scant support. It was considered that this was merely playing at business, and that the training so acquired would be of little use in practice. Some witnesses preferred for their higher posts, when these were not recruited from the lower ranks, University men; others considered that the last year or two of educational life could best be spent in a foreign country acquiring a knowledge of its language and its business methods. On the whole, opinion was favourable to such institutions as the London School of Economics previously mentioned, in which special teaching could be given to those who had made up their minds what line of business they were about to adopt, or were even already engaged in it.

"Eventually the Committee decided to recommend (1) the establishment and encouragement of continuation schools for those who entered business offices at about the age of 14, that is to say boys trained in the elementary schools; (2) that departments should be established in many of the secondary London day schools for the preparation for commercial life of boys leaving school at 16, the education to be given being of a general character—modern languages, arithmetic, and commercial geography; (3) that there should be formed in at least one secondary London day school of the first grade, a department for the preparation for business life of boys leaving school at 18 or 19, the teaching of which should qualify its pupils either to enter the higher ranks of commercial life, or to pursue an advanced course of study in some institution of higher commercial education; (4) that in the reorganisation of the London University, which is now under consideration, provision should be made for the establishment of a separate faculty of economic and commercial science, to which pupils of Class 3 could go."

It appears that the Chambers of Commerce take one view, and the individual employers consulted by the London County Council take a somewhat different one, and it is hard to reconcile one view with the other. It seems to me almost axiomatic that before any specialisation ought to take place a good general education must be given to all boys who enter a secondary school. Parents themselves are not always wise, and they usually think that unless the education given at a school has a

very direct bearing on the boy's future life, it is time wasted. They forget that the aim of education is to train and exercise the mind, as it is the aim of physical exercise to train the body.

As regards physical exercise the boys themselves are wiser than their parents, for they usually take the matter into their own hands, and the utilitarianism of football does not enter into their heads, but they are satisfied that they are all the better for it. The mental gymnastics that are performed in a good solid secondary education may not be directly utilitarian, but they train the faculties and render them capable of being turned in profitable directions at a later time of life.

The presence of a well-educated man or boy, who has passed through the usual curriculum of a good secondary school, makes itself felt, not only by his employers, but by his colleagues. There is about him a something which is not to be found in one who has not had that advantage. He has been at school with those who have not taken his own career, and he has had his character trained; and it is not too much to say that whether he is conducting inside the office or outside it, he will have a greater weight and be able to negotiate on more equal terms than others who may be said to have risen from the ranks. He is, in nine cases out of ten, more to be trusted and more diplomatic if he has had the training that a gentleman should have. For this reason, if for no other, the attempt to shorten the secondary school education proper, by introducing in it specialisation which will take the pupil away from his ordinary classes is to deprecated. One other reason may be given, and that I have already implied, the boy will be more ripe for specialisation than if it is forced on him earlier.

It is the few, compared with the many who go to elementary schools, who can be sent to secondary schools, and it is the few who can hope to obtain the moderately high posts in business houses. The inferior posts are held by those who as a rule have to be contented with elementary education up to the age of 14. Boys at secondary schools remain in them up to 16 and to 19, according to the grade of the school, and it may be taken as an unfortunate fact that the largest bulk of those who pass from the secondary school to business have been in schools where the leaving age is between 16 and 17. It is only those who are certain of employment in the highest posts in a business house who can afford to stay in a first grade school where the leaving age is 19, and we hear that if they proceed to the universities they are preferred.

The State in recent years has aided secondary education in perhaps what may be considered an indirect way, but it has done so very effectively. It is very largely due to its action that the non-leisured classes have had the possibility of being educated on modern lines, lines which are at least equally as effective in training the mind as were the old and more time-honoured mediæval methods. The benefit of the modern education, besides giving mental training, is that it is a direct preparation and foundation for subsequent specialisation. To be taught English well—history and geography being collated together as a part of the same subject—and in a scientific manner, is an excellent foundation for all commercial work. The recently developed methods of teaching practical mathematics and modern languages are also excellent preparations for what must come after in business education; and, again, the training of the observational and reasoning faculties by studying natural knowledge (science) must also give a stability to the intellect which must prove a very valuable asset to the commercial man.

In aiding such a secondary education the State has been of infinite benefit to commercial education, but when it comes to specialisation it has so far considered that its aid should cease when specialisation commences. It equally refuses to aid other forms of technical instruction in day schools. The instruction which it aids is that suitable for youths up to 16 or 17, ages below which it is, as already said, inadvisable to encourage specialisation. There are two classes of secondary schools which it aids—one in which there is a predominance of science teaching, if mathematics are included, and the other in which the minimum of science which can be considered satisfactory according to modern views is taught. The grants to these schools are nominally made for the science instruction, but it enforces a preliminary qualification. It has to be shown that the non-science instruction is well carried out. Further it insists that at least one modern language must be taught. I look upon this condition as a most important one. It is quite possible to get up such subjects as book-keeping and mercantile law in a short time, but it is impossible for youths, as a rule, to become really proficient in a language unless they have some elementary scientific training in it in their early school career.

If a business man wishes for adequate representation for his trade abroad, it is not to be supposed that the language acquired for home consumption will suffice, but it must be such as will be understood in the country to which the representative is sent. The employment of foreigners in English business houses is a standing slur on the instruction in foreign languages that used to be given in the ordinary school. A glance at the Table will show how few under 16 are successful in languages, the examinations being based on modern methods of teaching. The foundation only but not more can be laid before that age. Time has to be given to the study of the language from an analytical point of view, and not merely to its cheap and uncultured utilitarian aspect. If a modern language be taught with the same attention and analytical skill as Latin, and added to this there is taught the power of expression with a good accent, the days of the foreign invaders into mercantile houses are surely numbered. In the encouragement of teaching languages the State, it may be said, is almost directly aiding, during school-days, what will be of future use to the pupil. In regard to what are called "schools of science," there is nothing taught in the elementary course (which lasts two years, and in which the ages of pupils vary from about 13 to 16) which every boy ought not to be acquainted with. The English subjects, the language, and the notions of elementary science (taught practically) are equally as necessary for the business man as they are for those who are going into industrial pursuits or the professions. If a boy has profited by his elementary course of study, including his science, he is well prepared for carrying on his studies further. The rub is the further. There is some excuse for allowing specialisation of study after such a course, and it appears to me that a commencement of the study of subjects that are applicable to commerce might be entered upon, but only taken with the subjects which are necessary for continuing the general education. At this stage it would be useful if the State allowed a differentiation of study to be made, and that the pupils might be kept at school to learn a little of those subjects which have a bearing on their career, rather than being obliged to take a strictly science course to the end. I need scarcely remind the Society that a knowledge of science is of extreme use in commereial enterprise. It is impossible to pick up intelligently a knowledge of materials, for instance, without having studied chemistry, so that science in some degree ought to be carried on to the end of the school career. Side by side with these schools of science there are often the other class of schools which are aided by the State. These spread out the elementary course of science over four years. When the two classes of schools are within easy reach of each other, or in the same town, there is not the same necessity for giving an option as to modifying in the higher course of the school of science. The pupil who intends to go into business can go to that one where the opportunities and facilities for specialising in commercial subjects are greater. This, however, is a matter of detail, into which it is unnecessary to enter.

It must also not be lost sight of that in the "whiskey money" the new education authorities (as had the County Councils under the Technical Instruction Act) have a large sum of public money at their disposal for aiding technical, agricultural, and commercial instruction. This money has been mortgaged up to the hilt, it may be said, in most cases, in furthering all these spheres of instruction, but it has to be confessed that the technical has perhaps had the best of it. There is, however, a proviso in the Education Bill of 1901 that the local authorities have power to raise a rate for the purposes of secondary education, and certainly commercial subjects should come under the benefits of the rate. I am not certain what is intended at the present moment, but up till last year it was a rule that scholarships to schools might be given for varied purposes, the cost of such scholarships being met by practically equal contributions from the locality and the State. The rate raised by the locality was recognised as meeting the local contribution. If the same rule exists now, as did such a short time ago, it is a form of State aid which might be wisely used in keeping promising pupils at school till they had specialised in those subjects which would ultimately be of use in their after careers.

So far I have dealt with the action of the State in regard to commercial education without more than a brief reference to the examinations by the Society. I must say a few words regarding them. In the first place I will refer to a paper by Sir H. T. Wood read in 1897 at the International Congress of Technical Education which was held in these rooms, and which has since been republished with the necessary additions in August of this year. It appears that each decade has shown a large increase in the popularity of these

examinations. In 1883 there were 808 candidates and 35 centres of examination; in 1893 3,702 candidates and 109 centres; in 1903, 10,616 candidates and 322 centres of examination.

If a freehand curve in which these numbers and years and the intermediate numbers and years are shown as ordinates and abscissæ respectively it will closely resemble a logarithmic curve ($y = a^x$ where a is ·0648 and x is zero in the year 1869), and though it is unwise to rely too much on extrapolation, yet it is right to use it to see to what numbers of examinees might be expected in future years. The following Table is deduced from the curve and the extrapolation of it:—

	Actual Numbers.	Calculated Numbers.
1883	800	800
1884	1,000	938
1885	1,200	1,100
1886	1,200	1,260
1887	1,200	1,450
1888	1,400	1,630
1889	1,700	2,000
1890	2,200	2,310
1891	2,500	2,700
1892	3,400	3,090
1893	3,700	3,600
1894	4,100	4,170
1895	4,800	4,800
1896	6,100	5,600
1897	6,900	6,500
1898	7,600	7,600
1899	8,800	8,806
1900	8,900	10,200
1901	13,300	11,800
1902	13,400	13,300
1903	16,200	16,000
1904	—	18,400
1905	—	21,400
1906	—	25,200
1907	—	29,000
1908	—	34,000
1609	—	39,100
1910	—	45,400
1911	—	52,800
1912	—	61,300
1913	—	71,200

This represents an increase of a very little over 15 per cent. each year, a percentage which was familiar for a long time in the old Scence and Art Department, whose examinations increased in like proportion for some years. We perhaps need not consider what is to happen in ten years, but it behoves us to look at least five years ahead. If the curve be correct approximately, this means that in five years time the numbers examined will be rather more than doubled. As mentioned in the beginning of the address, this house is barely sufficient for our actual wants at the present time, and throwing on the Society double the number of papers to be looked through by the examiners, and tabulated and collated by the staff, means that much additional space will be required, and more staff, in order to cope with the increased work. It is a matter for rejoicing that the popularity of the examinations is increasing. But the popularity must ever be a severe tax on the Society—not, however, a money tax, for the examinations so far pay their own cost, and the cost of examination per individual diminishes somewhat as the numbers of examinees increase. But it will tax the Society to find space in which to conduct the work, and will give additional responsibility to our secretary, to whom very much of the success attained already is due. It may soon, however, be a question whether the State itself ought not to take over this work. It cannot be dropped. It must continue, but when the dimensions become unwieldy it is evident that relief from the burden will have to be found in some direction. I believe the country and the members have every reason to be satisfied with this part of the work of the Society. It was originally a small part only, but it is gradually increasing into being a very large part of the Society's work. It must in no case interfere with those other useful functions for which the Society exists.

The question of improving or slightly enlarging the scope of the examinations is under the consideration of the Council, and if it is found that there is a desire for a raising of the standard of qualification in order to pass in the highest grade, or perhaps to add an additional grade, I believe that the Council will undertake to carry out the improvement, and will organise the further examination.

I have not touched upon the other functions of the Society, as I have felt that the subject of our examinations alone is a theme on which a sufficiently long address can be made. I fear I have taxed your patience in regard to details.

After delivering the Address the Chairman presented the Society's medals which were awarded for papers read during last Session.

For papers at the Ordinary Meetings :—

To DR. GUSTAVE GOEGG, for his paper on "Le Tunnel du Simplon, et la nouvelle ligne de Chemin de fer directe Anglo-Italienne pour l'Orient."

To ARCHIBALD P. HEAD, Mem.Inst.C.E., for his paper on "The South Russian Iron Industry."

To PROF. W. SMART, LL.D., for his paper on "Industrial Trusts."

To DR. BENEDICT W. GINSBURG, for his paper on "The Port of London."

To ALFRED C. EBORALL, M.I.E.E., for his paper on "Application of Polyphase Motors to the Electrical Driving of Workshops and Factories."

To GABRIEL J. MORRISON, for his paper on "The Construction of Maps and Charts."

To E. NORTH BUXTON, for his paper on "Preservation of Big Game in Africa."

To EGERTON CASTLE, for his paper on "Swordsmanship considered Historically and as a Sport."

In the Indian Section :—

To MISS ELLA C. SYKES, for her paper on "Domestic Life in Persia."

To SIR CHARLES JAMES LYALL, K.C.S.I., M.A., LL.D., for his paper on "The Province of Assam."

In the Colonial Section :—

To THE COUNTESS OF ABERDEEN, for her paper on "Women in Canada."

To HERBERT SAMUEL, M.P., for his paper on "The Uganda of To-day."

In the Applied Art Section :—

To G. F. BODLEY, R.A., for his paper on "Some Principles that may be Guides for the Applied Arts."

To MISS HANNAH FALCKE, for her paper on "Artistic Fans."

The Chairman then presented the following medals which were awarded for exhibits at the International Fire Prevention Exhibition, at Earl's-court :—

For 80 feet Long Ladders :—

Gold medal to Mr. C. D. Magirus, of Ulm.

Bronze medal to Messrs. J. C. Braun, of Nuremberg.

For Chemical Engines for Town Use :—

Silver medal to Mr. W. Busch, of Bautzen. (Heavy.)

Silver medal to Messrs. Merryweather Ltd., of London. (Light.)

Bronze medal to Messrs. J. C. Braun, of Nuremberg. (Heavy.)

Bronze medal to Messrs. Sinclair and Co., of London. (Light.)

For Compressed Air Engine for Town Use :—

Silver medal to the Kühlstein Wagenbau Gesellschaft of Berlin.

Sir JOHN WOLFE BARRY, K.C.B., said it was a matter of profound satisfaction that the destinies of the Society would be directed by so distinguished a man as Sir William Abney, who was a past president of the Astronomical Society, of the Physical Society, of the Photographic Society, and Section A (Physics) and Section L (Education) of the British Association. As a photographer, the Chairman was, he supposed, more distinguished than any other gentleman who had directed his attention to the subject, either in this or in any other country. But, apart from such matters, Sir William had taken a long and absorbing interest in the great subject of education. He was for some considerable time head of the scientific branch of the Board of Education at South Kensington, having only recently retired from that position. Therefore he spoke as one who was more thoroughly acquainted with the subject of education, both scientific and commercial, than anybody whom one could meet in the Kingdom; and as such he had dealt with the details of a subject, the importance of which could not possibly be exaggerated. Sir William had done a real service to the Society in bringing the subject forward in his opening address, in so thorough a manner. He also thought that everybody who gave careful consideration to the subject of education, would be at one with the Chairman on the general condition he laid down—that a student should first of all lay a thorough grounding of general education before attempting to specialise in the various subjects to which he intended to devote his life. It was easy to think that one could take a short cut to full scientific or commercial education; but the experience of everybody acquainted with the subject was that that was impossible, and that unless a youth was thoroughly grounded first, it was hopeless to arrive at a good result by early specialisation. He thought the members ought to be grateful to Sir William for laying down that canon with all the authority which belonged to him, from his careful study and great experience on the subject. It was a great source of gratification to him, as a past chairman of the Council of the Society, to be able to hear from Sir William's lips that the progress of the Society in the matter of education was at least as great, if not greater, than it was when he himself occupied the chair of the Council, and that the great progress which had been achieved in the past would be continued in the future. He felt certain that, under the careful guidance of the Chairman and Sir Henry Trueman Wood, the progress would continue, and that the utility of the Society would grow greater and greater as time went on. He assured Sir William, on behalf of those who were able to be of any assistance to him, that they would be proud and anxious to devote the best of their ability to the support of the Chair of the Council. He concluded by proposing a hearty vote of thanks to the Chairman.

Sir OWEN TUDOR BURNE, G.C.I.E., in seconding

the motion, expressed his opinion that they were specially fortunate in having Sir William Abney to preside over the Council. As Chairman during the International Congress on Technical Education in 1896, he (Sir Owen) thoroughly appreciated all that the present Chairman had brought forward on so difficult a subject.

The motion was put to the meeting by Sir JOHN WOLFE BARRY and carried unanimously.

The CHAIRMAN, having briefly acknowledged the compliment, the meeting terminated.

Miscellaneous.

AGRICULTURE IN THE EAST AFRICA PROTECTORATE.

For agricultural purposes the East Africa Protectorate may be divided into two sections—the lowlands and highlands. By the former are meant the districts on the coast, along the Tana and Juba rivers, and around Lake Victoria; by the latter, the central plateaux situated in the provinces of Ukamba, Naivasha, Kenya, and Kisumu. The lowlands may be described as being everywhere a moderately rich tropical country, and in parts exceedingly rich. Cocoanuts are abundant, and copra is exported. The best trees are found in the Lamu Archipelago and the districts to the south of Mombasa. It is said that the coast from the Lamu Archipelago to Vanga offers as good a field for the cultivation of the cocoanut palm as Ceylon. India rubber is also already a considerable export, which it is hoped will greatly increase with time. The East African rubber is a creeper of the genus *Landolphia*, the best quality being *L. Kirkii*. It is found growing up trees in the Arabuko and Mueli forests, on the Tana river, near Witu, in Gosha, and generally wherever forest or sub-forest is met with. Gum copal is also found in many forests, and the timber has been well reported on. There is a large export of boritis or mangrove poles, known in the trade as Zanzibar rafters. Rice, maize, and various grains are, according to H.M. Commissioner at Mombasa, very abundant, and he is of opinion that there are two important branches of tropical agriculture which will flourish in the lowlands—particularly if they are undertaken by firms who are unable to prosecute them on a large scale—namely, tobacco and cotton. Tobacco is being grown at present near Gasi, to the south of Mombasa, and it is said that the results obtained are satisfactory. A leaf of superior quality is also reported to have been grown near Lamu by a German firm some years ago. With regard to cotton, the data are more uncertain. An indigenous variety grows freely in Tanaland and Gosha, and the natives make a rough but quite serviceable stuff from it, while, about ten years ago, a German firm experimented with imported seeds near Lamu. It is not known what was the quality of the seeds which they used, but the reports on the cotton, which they sent to Liverpool, Naples, and Germany, have been preserved, and are most satisfactory. The samples were classified as "resembling lower quality Sea Island" and "between Tahiti and Sea Island," and priced at from 7d. to 9d. per pound. The experiments were abandoned, partly because Lamu fell subsequently to the British and not the German sphere, and partly on account of the difficulty of obtaining labour. Circumstances have now changed, and this latter difficulty exists no longer. It would appear that a large part of the provinces of Tanaland and Seyidie is eminently suited to the cultivation of cotton. Certain varieties are said to grow well on islands close to the mainland, and the Lamu Archipelago presents exactly the conditions required. The Tana should offer a suitable soil to those varieties which prefer river banks. The river is in many parts extremely tortuous, and forms a succession of promontories on either side, a quarter of a mile long and not much more than fifty yards across. These are often overflowed, and in any case irrigation would be easy. It is also reported that *Indigofera arrecta* is indigenous and abundant on the coast. This is said to be the richest of indigo-yielding plants, and the only one which can compete commercially with artificial dyes at the present time. The fringe behind the coast produces two or more rain crops of maize during the year, but has little or no surface water. In the highlands the chief indigenous vegetable products which have a commercial value are rubber, fibre, and castor oil beans. The castor oil plant grows wild nearly everywhere, and the beans are easily improved by cultivation. Their value in the Protectorate is about £2 10s. per ton. Various kinds of fibre are abundant, and have been well reported upon both for length of staple and quality. A kind of coarse tobacco also grows wild. The success which has attended the cultivation of introduced plants is remarkable. Almost every sort of European vegetable and fruit can be grown in good quality and quantity. An export trade of potatoes to the Cape is beginning, and when once the transport has been properly organised, practically unlimited supplies can be sent. Coffee, from seed introduced from British Central Africa, is being grown in Kikuyu on two plantations, and the trees are in a most flourishing condition. A little cotton has also been grown near Nairobi, and the sample sent home has been valued at 6d. per pound. Sunflowers grow in profusion, and might, it is said, be made a paying industry, as the seed is said to realise over £11 per ton in Russia. An attempt is being made to start a silk industry in the Kenya Province, as it is found that Japanese mulberries thrive there. The enormous grazing-grounds afford pasturage to large herds of

native cattle and sheep, but at present the only European cattle are a few animals kept by private persons, and no attempts have been made to try grazing on a large scale.

QUEENSLAND.*

After a brief allusion to some of the main landmarks in the history of Queensland, the paper proceeds to give a general sketch of the physical features of the State, describing its mountain and river systems, and the three great natural regions into which it may be subdivided on physical and climatic grounds. These are (1) the eastern division, lying between the coast and the great dividing range, consisting of well-watered fertile lands, clothed in the northern part with vegetation of unsurpassed luxuriance; (2) the watershed of the Gulf of Carpentaria, wholly tropical, but mainly adapted rather for pastoral than agricultural purposes; and (3) the vast western district, embracing the famous downs country, unsurpassed for richness of soil and magnificence of climate, the only drawback being the uncertain and scanty rainfall, the want of which is, however, to some extent supplied by its artesian resources. The geological structure, in regard to which an entire difference is noticeable between the east and west of the State, is next comprehensively described, attention being paid to the influence of geological facts on the possibilities of artesian development. The mineral wealth—consisting primarily of gold, but including copper, silver, antimony, and tin ores; coal, opal, gems, bismuth, wolfram manganese, and lead—is described as practically inexhaustible, and an account is given of the most valuable deposits yet exploited. The main characters of the flora and fauna are next described, special attention being paid to the products of most economic importance. In describing the climate of Queensland, the author points ont the special advantages possessed by the southern districts and the curative properties of the dry and buoyant air of the western plains. The distribution of the rainfall is discussed, and details are given of the artesian water supply which supplements this in the interior districts. Possibilities of storage of river water for irrigation are also touched upon. Coming next to the industrial resources of Queensland, the author points out the unrivalled advantages given by its position with regard to the great commercial highways of the East, its fine natural harbours and its coast protected from the ocean by the Great Barrier Reef. The present population is but a fraction of that needed for its satisfactory development, and the immigration of Polynesians is a necessity for the cultivation of the tropical portion. At present the pastoral industry is more fully developed than either mining or agriculture, the sheep, cattle, and horses numbering some scores of millions when not handicapped by droughts. The agricultural industry is at present limited to the eastern settled district, from Cookstown south, but with irrigation the rich western region might produce immense quantities of grain. In addition to sugar, the coast region produce maize, tobacco, coffee, cotton, arrowroot, &c., and fruit-growing might be taken up with profit. The great need is an enormously larger population to settle on the land and develop its vast resources.

* Abstract of a paper read by Mr. J. P. Thomson before the Geographical Section of the British Association at Southport.

THE MANUFACTURE OF PERFUMES IN GRASSE.

The city of Grasse, the most important industrial place of the Riviera, is widely known on account of its perfume manufacture. At present 35 establishments making essences of flowers are in operation there. The average consumption of roses for that purpose is about 2,650,000 pounds, and that of orange flowers about 660,000 pounds per annum. The annual sale of these essences amounts to about £200,000. Vallauris has nine such factories. The most important product of this industry is oil of neroli, made from the flowers of the bitter orange. A kilogramme (2·2 pounds) of this oil is worth £12. From the peel of the bitter orange, oil of orange is made. The peel of the sweet orange is seldom used for making oil. The manufacture of essence of roses is also very extensive. The so-called oil of roses is manufactured from the *Andropogon schœnanthus*. The flowers of the large-flowered jasmine yield the oil of jasmine. One acre planted with jasmine is said to yield a yearly product worth £250, but requires a good deal of work. A pound of essence of violets is worth from nine to ten shillings. Oil of geranium is produced from the flowers of *Pelargonium capitatum*. The flowers of the tuberose, of the jonquil, and of a species of narcissus are manufactured into essences; also the leaves of the citronella plant, the root of the *Iris florentina* (violet root), the patchouli flowers, sandalwood, &c. Fortunately for many places in the Riviera, the consumption of these essences has not decreased in late years.

General Notes.

COACHBUILDING PRIZES.—The Company of Coach Makers and Coach-harness Makers of London offer the following prizes for competition among the British subjects engaged in the trades of coach making and coach-harness making and accessory trades, and members of drawing and technical classes in connection with such trades, resident in the United Kingdom of Great Britain or Ireland. Competition No. 1 (open to teachers of technical classes and previous prize winners in the Company's competitions) —For drawings of a sound strong jobmaster's "Char-

a-banc," to seat twenty passengers inside, safe and easy access behind; scale 4 inches to the foot, on paper 6 feet by 4 feet 6 inches; 1st prize, the Company's silver medal and £5 5s.; 2nd prize, the Company's bronze medal and £2 2s. Competition No. 2 (open to all, except teachers and previous prize winners in the Company's competitions)—For a drawing of a small light omnibus, to seat six persons inside, allowing 16 inches for each person (measuring the front of each seat); side and half-back elevations required; scale 4 inches to the foot; on paper 6 feet by 4 feet 6 inches; 1st prize £5 5s.; 2nd prize, £2 2s.; 3rd prize, £1s. 1s. Competition No. 3 (open to all)—For side view, plan and section drawings to full working size (coloured) of all the metal-work, exclusive of wheels, axles and springs, of an ordinary double brougham; 1st prize, £3 3s.; 2nd prize, £1 1s. Competition No. 4 (confined to coach trimmers)—For the best made pair of spring cushions for a brougham, any size, but the depth not to exceed six inches, the springs not necessarily steel; all other points of merit being equal, preference will be given to the shallowest in depth; scale 3 inches to the foot; 1st prize, £5 5s.; 2nd prize, £2 2s. Competition No. 5 (open to all)—The Company offer a silver and bronze medal and the Master £10 10s., for a motor-car body to carry four people in the hind part and one or two on the driver's seat, suitable for a petrol engine; the wheels 2 feet 4 inches to 2 feet 10 inches over the tyres, spring centres 2 feet 6 inches, and axle centres not more than 8 feet; the hind part to be convertible from an open to a closed carriage; side view and half plan; scale 3 inches to the foot, in ink or coloured on one piece of paper 6 feet 4 feet 6 inches; the Automobile Club has been asked to appoint two judges, and the Court of the Company will appoint two others for this competition; 1st prize, the Company's silver medal and £6 6s.; 2nd prize, the Company's bronze medal and £4 4s. Competition No. 6 (open to those under 18 years of age who have never won a prize in the Company's competitions)—For drawings in ink of a T cart, side view; scale $1\frac{1}{2}$ inches to the foot; on one piece of paper 18 inches by 12 inches; 1st prize, £2 2s.; 2nd prize, £1 1s. The above prizes will be accompanied by the certificate of the Company. The prize winner in any of the competitions, if not already Free of the Company, may have the Honorary Freedom conferred upon him, should his drawing or his essay in the opinion of the judges deserve it. Students of technical classes who may desire to exhibit models of carriages or parts of carriages can do so, and if they have sufficient merit the judges may award medals or money prizes at discretion.

Düsseldorf Exhibition, 1904.—The Board of Education have received a communication from the Foreign Office intimating that an International Fine Art and Horticultural Exhibition is to be opened at Düsseldorf on 1st May, 1904. A hope is expressed that England will contribute largely to this exhibition.

MEETINGS FOR THE ENSUING WEEK.

Monday, Nov. 23...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lecture.) Mr. Bennett H. Brough, "The Mining of Non-Metallic Minerals." (Lecture I.)
Surveyors, 12, Great George-street, S.W., 8 p.m. Mr. Herbert T. Scoble, "Industrial Decentralisation, an Important Factor in the Solution of the Housing Problem."
Geographical, University of London, Burlington-gardens, W., $8\frac{1}{2}$ p.m. Lieut.-Col. Manifold, "Recent Exploration and Economical Development in Central and Western China."
Camera Club, Charing-cross-road, W.C., $8\frac{1}{2}$ p.m. Mr. Harding King, "A Journey in the Sahara."
Medical, 11, Chandos-street, W., $8\frac{1}{2}$ p.m.
London Institution, Finsbury-circus, E.C., 5 p.m. Mr. J. D. Rees, "Persia and the Persian Gulf."

Tuesday, Nov. 24...Medical and Chirurgical, 20, Hanover-square, W., $8\frac{1}{2}$ p.m.
Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Mr. Hugh Robert Mill, "The Distribution of Mean and Extreme Annual Rainfall over the British Isles."
Anthropological, 3, Hanover-square, W., $8\frac{1}{2}$ p.m.
Colonial Inst., Northumberland-avenue. W.C., $4\frac{1}{2}$ p.m. Hon. Sir Horace Tozer, "Queensland: its Material Progress and Natural Resources," by Dr. J. P. Thomson.

Wednesday, Nov. 25...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. George F. Parker, "The Universal Exposition at St. Louis, U.S.A., 1904."
United Service Institution, Whitehall, S.W., $3\frac{1}{2}$ p.m. Fleet-Engineer G. Quick, "Some Remarks on Screw Propulsion for War Ships."
Royal Society of Literature, 20, Hanover-square, W., $8\frac{1}{2}$ p.m. Dr. Richard Garnett, "Date and Authorship of the Treatise on the Sublime attributed to Longinus."
British Astronomical, Sion College, Victoria-embankment, E.C., 5 p.m.

Thursday, Nov. 26...Royal, Burlington-house, W., $4\frac{1}{2}$ p.m.
Antiquaries, Burlington-house, W., $8\frac{1}{2}$ p.m.
London Institution, Finsbury-circus, E.C., 6 p.m. Sir William Ramsay, "Radium and the Periodic Law in connection with recently discovered Elements."
Electrical Engineers, 25, Great George street, S.W., 8 p.m.
Camera Club, Charing-cross-road, W.C., $8\frac{1}{4}$ p.m. Mr. E. R. Ashton, "Picturesque India."

Friday, Nov. 27...Clinical, 20, Hanover-square, W., $8\frac{1}{2}$ p.m.
Physical, Chemical Society's Rooms, Burlington-house, W., 5 p.m.

Saturday, Nov. 28...North-East Coast Institute of Engineers and Ship-builders (Graduate Section), Newcastle-on-Tyne, $7\frac{1}{2}$ p.m. Mr. O. E. Berriman, "Automobilism."

Society of Chemical Industry.—The Secretary is anxious to obtain Vols. 1 and 2 (1882–3) of the *Journal* of the Society of Chemical Industry to complete the set in the Library. He would be glad to hear from any member who could place these volumes at the Society's disposal.

Journal of the Society of Arts,

No. 2,662. Vol. LI.

FRIDAY, NOVEMBER 27, 1903.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

NEXT WEEK.

Monday, November 30, 8 p.m. (Cantor Lecture.) Bennett H. Brough, "The Mining of Non-Metallic Minerals." (Lecture II. The Salts.)

Wednesday, December 2, 8 p.m. (Ordinary Meeting.) Sir Charles Malcolm Kennedy, K.C.M.G., C.B., "The Fiscal Problem."

Further details of the Society's meetings will be found at the end of this number.

CANTOR LECTURES.

On Monday evening, November 23rd inst., Mr. Bennett H. Brough delivered the first lecture of his course on "The Mining of the Non-Metallic Minerals."

The lectures will be printed in the *Journal* during the Christmas recess.

JUVENILE LECTURES.

The usual short course of lectures adapted for a juvenile audience will be delivered on Wednesday afternoons, January 6th and 13th, at 5 o'clock, by Eric Stuart Bruce, M.A., on "Navigation of the Air."

Each member is entitled to a ticket admitting two children and an adult.

A sufficient number of tickets to fill the room will be issued to members in the order in which applications are received.

Members who desire tickets for the course are requested to apply for them at once.

Proceedings of the Society.

SECOND ORDINARY MEETING.

Wednesday, November 25, 1903; Mr. Henry H. S. Cunynghame, C.B., in the chair.

The following candidates were proposed for election as members of the Society:—

Ashton, Augustus George, 90, Chesnut-road, Plumstead, S.E.

Carter, Gillmore T., Dorset-house, Kingsdown, Bristol.

Gutekunst, R., 16, King-street, St. James's-square, S.W.

Higginson, Eduardo, Consul for Peru, Southampton.

Krebs, Rev. Stanley L., A.M., Greensburg, Pa., U.S.A.

Turbervill, Malcolm W., Stanwell-house, Lymington, Hants.

The paper read was—

THE UNIVERSAL EXPOSITION AT ST. LOUIS, U.S.A., 1904.

By George F. Parker.

The next in the series of the great international exhibitions will open its gates in St. Louis, Missouri, on the first day of next May and close on the first day of December following.

This will be the third exhibition of the first rank held in the United States, each of which illustrated a sentiment. In 1876, at Philadelphia, was celebrated the Centennial of the Declaration of Independence; at Chicago, in 1893, was commemorated the four hundredth anniversary of the discovery of America by Columbus; while the third will recognise the centenary of the acquisition of the great territory known as Louisiana, out of which has been carved the State bearing the name, and the eleven additional States of Arkansas, Colorado, Iowa, Kansas, Minnesota, Missouri, Montana, Nebraska, North Dakota, South Dakota, and Wyoming, and the Indian territory and Oklahoma. In round figures, the area is a million square miles, *i.e.*, more extensive than the whole of the United States at the beginning of the 19th century. Its population has now passed fifteen millions, and the rate of increase goes on with almost unprecedented rapidity.

Looked at from the historical point of view this great territory was formerly shifted back and forth, a sort of pawn upon the chessboard of European politics, now belonging to Spain, now to France, and again disputes raging over its possession. Only a year or so before Napoleon sold it to the United States it had been in the possession of Spain, so that the people who then lived upon it had the distinction, without moving, of saluting three flags within two years. It was only natural that Napoleon, then engaged in deadly warfare with England, and soon to be involved with the whole of Europe, should dispose of a distant territory which he could neither use nor defend in case of attack. In this, perhaps, he showed a wise foresight, but he was not moved by any friendship to America or its institutions, but the fear of his enemies, and the desire to strengthen his hold at home, induced him to suggest its sale as a whole. He recognised that, even if he should be successful in his wars with Europe, he might easily be involved in a conflict with America over the right to use the Mississippi River, so that whether foresight, necessity, or destiny entered most into account, the transfer would, in any event, soon be made.

Its effect upon the history of mankind can scarcely be exaggerated. The late Professor Seeley in his "Expansion of England," when considering the elements which had entered into American growth after independence, said:—

"American happiness, then, is in no great degree the consequence of secession. But does she owe to secession her immense greatness? When we look back over the stages of her progress, we are able easily to discover that she has in several points been remarkably favoured by fortune. Imagine, for instance, that the original colonies, instead of lying in a compact group along the coast, had been scattered over the continent, and had been separated from one another by settlements belonging to other European States. Such a difference might have made the growth of the Union impossible. Imagine, again, that the French colony of Louisiana, instead of failing miserably, had advanced steadily in the hundred years between its foundation and the American Revolution. This colony embraced the valley of the Mississippi. Had it been successful, it might easily have grown into a great French State, held together through its whole length by its immense river. Or, again, suppose it had passed into the hands of England. It was Napoleon who, by selling Louisiana to the United States, made it possible for the Union to develop in the gigantic power we see."

We have, then, briefly to consider the importance of a universal exhibition bearing to the world relations like that to be held in 1904. The fact may well be borne in mind, whenever attention is directed to the western hemisphere, that perhaps more buyers and sellers, more producers and consumers, more persons interested in commercial development will, in 1904, congregate at St. Louis from Mexico, Canada, Cuba, Porto Rico, and all Central and South American countries, than it would be possible for the seller or his representatives to see, even by the most extensive travel through those countries within the same period.

It is not always borne in mind that a remarkable increase of population has taken place recently within the territory west of the Mississippi, included in the Louisiana purchase. In 1880, the fourteen States and territories, made from the original Louisiana, had a population of only 8,154,139; in 1900, the returns of the twelfth census showed that it had grown to 14,572,189, an increase of nearly 79 per cent. within the twenty-year period. As this human increment was distributed over a million square miles, it is, perhaps, safe to assert that such a rapid increase of population over so large an area of the earth's surface, within an equal period, is unexampled in all history. While no such ratio as this would be expected in the older States to the eastward, a growth has been made in the adjacent States of the south and south-west, contributing to the Mississippi Valley, which, within the same time, has added still other millions to the producers and consumers of the world.

It may be useful to compare this ratio of increase with that of other parts of the United States, as well as with the most progressive and rapidly-growing countries of the world. The population of the United States showed an increase, during the period under review, of about 52 per cent.; Germany, which contained 45,194,172 persons in 1880, had, in 1900, 56,345,014, a ratio of about 24 per cent.; while the United Kingdom, which in 1881 numbered 35,281,482, had, in 1901, become 41,605,220, a growth of about 18 per cent. It is scarcely necessary to enter more fully into such comparisons, because no other of the prosperous, the great buying and selling peoples of the world, are growing with such rapidity as these three.

The returns of the property values indicate an increase of from 125 to 150 per cent., to which agriculture contribute its full share. Whole States and territories, which in 1880 had almost no population, and where only

scattered improvements had been made, have now become the granaries of the world, and new homes for hundreds of thousands of industrious and active people have been created. This increase is shown not only in numbers and in wealth, but in purchasing power, in taste, and in demand. As already noted, the most conspicuous growth has been in the farming population, *i.e.*, men who have gone out from every country in the world, to take up homes, and to bring into cultivation the wild lands of the West, and have themselves developed into independence or comparative wealth.

In 1879 the United States exported 150,501,506 bushels of wheat. In 1899, twenty years after, the amount supplied was 222,618,420 bushels.

This enhanced foreign supply, to which must be added the new demand in the home market, has been drawn from the communities now under consideration, wheat having gone out of cultivation in many of the older States, which have, in turn, become dependent upon the new West for their breadstuffs. Even a still larger proportion of the maize, of meat of every kind, and of minerals, whether exported or consumed, have been drawn from the same area. In like manner, a considerable portion of the growth in the export of raw cotton has come either from the States under discussion, or from others, which, like Texas, are immediately tributary to the same centres.

Even this does not exhaust the commercial capabilities which have been considered, thus far, in their relation to domestic production and European consumption. Four great railway systems have penetrated into Mexico, with which the relations of this great middle West are scarcely less close than with their own neighbouring States. The growth of population in Mexico has gone on at a rate continually increasing. Having been able, after many vicissitudes to command good government and stability, it has bounded forward at a rate seldom witnessed in a southern climate. In like manner, the relations of Canada, with its large and steady growth, have become more and more important as her development has gone on in Manitoba and the North-West territories. Here, again, the railway systems have established connections which, even the formal presence of the much-dreaded custom house, cannot break. Thus the North American continent has tended, all the time, to become a centralised, single commercial fact, in which boundary lines between countries play only a small part. With the enormous commercial activity of the United States, the fact remains that the ports on the Atlantic seaboard are not holding their own, relatively, to the remainder of the country, a fact due, in the main, to the rapid growth which is going on in the West and South, in other words, in the valley of the Mississippi.

The territorial development of the United States has now extended to the West Indies. Cuba, hitherto only imperfectly developed, is certain to be opened up within the next few years. With a stable government of its own, in close relation to and under the protection of the United States, and with the assured destiny of absorption into the Union, its possibilities of growth in population and wealth cannot be exaggerated. In like manner, Porto Rico bids fair to grow with scarcely less certainty, and to become a good market for manufactured products, and a source of supply for sugar and other food products. The relations of Central America to the great population which is to hold its own distinctive exhibition in 1904, are also becoming closer each year. South America, with its natural and rapid growth, is turning its attention, more and more, in the same direction, the expansion of the United States enhancing its value as a market for the absorption of manufactured products, and as a magnet which must still further attract both trade and population. Then, it is impossible to overlook the fact that relations with the whole of the South American continent, as well as with Asia, will be promoted by the completion, now assured, of the Panama Canal, by the direct intervention of the Government of the United States.

Turning to the question of imports from foreign countries into the United States alone, with one exception the lowest figure reached since 1880 and the present time was in 1898, when they fell to 616,049,654 dols. Within two years, *i.e.*, in the year 1900, they had increased to 849,941,184—until then the high water-mark of its history. That year's trade in English products was also a record one. Both these totals have largely increased since 1900. A large proportion of this was due to the demand created in the middle West, by reason of its prosperity, enhanced consuming power, and rapid advance in taste. All this merely serves to show that, in spite of the spread of mechanical industry in the United States, and the rapid development of national resources, the United States still remains, for foreign countries, the best, as it is far the largest and most profitable single market in the world

for the sale of imported manufactured products.

All these changes have brought into existence an entirely new constituency which is profoundly interested in international exhibitions, so that it will be possible in 1904 to reach a large number who have not heretofore come under the great educating influence accompanying foreign trade. It will thus be possible next year to draw the representatives of twenty millions of busy people, desirous of seeing and studying the latest developmenis of art, science, and industry, and anxious to do their part in the world's work, all of whom will have come upon the scene in America since the inception of the Columbian Exhibition.

All these facts, considered in connection with the rapidly shifting panorama of commercial development, make it incumbent upon peoples, as well as individuals, to study with care their surroundings. It will probably be found that the future of markets for products made in other countries, still lies largely in the United States—a result much more fully assured than the fear that rapid expansion in other parts of the world will seriously interfere with that delicate adjustment of the balances in which the industries of the world are weighed.

It is only natural that the preparations for celebrating an event of this importance should be made on a scale hitherto unknown. So long as the peoples of the world make their commercial appeals through the medium of these successors of the fairs of the Middle Ages, it is inevitable that each new one must be larger than any predecessor. The effect of this is certain to make the work of organising and carrying it on so great that they will become more and more rare. It this case, the Government of the United States has contributed 5,000,000 dols. directly to the Exhibition, and will expend nearly two millions in addition in making exhibits from the almost infinite number of scientific bureaus included in its various departments. The City of St. Louis contributed 5,000,000 dols., raised from an issue of municipal bonds, authorised by a vote of its people; a third sum of 5,000,000 dols. was raised by a local company, organised for the purpose, and into the hands of which has been given the management of details with a nominal oversight on the part of a United States Commission. When, as in this case, the Government contributes money to an exhibition, it makes severe rules and conditions in order that it may place upon local bodies the full responsibility for carrying out the work.

The State of Missouri has contributed 1,000,000 dols. to pay for an exhibit of its institutions and its industries, while every other State and Territory in the Union has made liberal arrangements for participation. In two or three of them the rigidity of their constitutions made it impossible for them to appropriate public money to be expended outside their boundaries, so their citizens have taken up subscriptions to ensure this result. Every State will erect a building as a headquarters for its own people. In most cases they reproduce the country houses of some of their worthies of earlier days, or their capitols. In some instances, notably that of the State of Washington, which will be built of immense trees on end, they will represent the most important of the local industries and so become part of the exhibits. These State structures will be grouped together on high ground, from which it will be possible to obtain a general view of the exhibit and foreign buildings. Each State will have one or more days when its people will be expected to attend in great numbers, a policy which is carried further by the assignment of special days for churches, industries, social and professional organisations. This will even be extended, in a few instances, to individuals.

Every important foreign country has accepted the invitation of the United States to take part, and in nearly all cases, a special pavilion will be erected as a rallying point for its people. With the exception of Switzerland, no European country has failed to respond favourably to the invitation, as even Bulgaria, Greece and Turkey will be included in the sixty foreign countries which will be represented officially. The great foreign exhibits will, naturally, come from Great Britain, Germany and France, between whom there has been a strong, friendly rivalry. Each of these countries has made a more liberal provision for representation than at any previous exhibition. Asia will show its peculiar industries more completely than ever before, China, Japan, Korea, Siam and Ceylon having arranged to erect separate buildings for themselves, and to be represented in nearly all the great buildings devoted to exhibits.

Canada, New Zealand, most of the South African Colonies and Egypt have appointed commissioners, while the Commonwealth of Australia will most certainly make official

exhibits—arrangements for which have hitherto been delayed by the prolonged droughts. One of the most conspicuous exhibits will be an outdoor exhibit of the Philippines covering thirty acres of ground. Mexico and every conntry in South and Central America will take part.

The City of St. Louis, within the corporate limits of which all these department and government buildings, covering about 150 acres, will stand, has long been the Metropolis of the Louisiana Purchase. It has grown, until, with a population which numbered three years ago 575,000, it occupies the fourth rank in American cities. It is pleasantly situated on the west bank of the Mississippi River, is the terminus of twenty-six separate railways, a central commanding market for grain and cotton, and one of the busiest of manufacturing centres, in many lines of industry. Its people are busy, conservative, own, to an unusual degree, the houses they live in, and manifest much public spirit. Its merchants and traders reach every part of the country, but especially to all the immense district within the Purchase, and the many States to the east a ong the Mississipi and Ohio rivers. Their activities are felt as determining factors in the business and life of something like twenty-four States. But development has gone on all along the line of human effort. Its people have not given themselves over wholly to the making of money. They are active and foremost in developing the religious, educational, social, and the charitable features which contribute so much to the life of a great city. Churches, hospitals, schools, provision for the dependent and defective, are everything that could be expected in a restless and enterprising community. Its people are so hospitable, that probably three-fourths of its homes, of every order, will be thrown open at some time for the free entertainment of guests during the progress of this latest of world's fairs.

The site chosen lies for the most part in Forest Park, a well-timbered tract of 1,300 acres, all within the limits of the city; about one-half of this will be occupied, the remainder, making up the 1,200 acres necessary, being private property. Included within the latter are the grounds of the Washington University, about 110 acres in extent, with the use of the buildings, only just completed. In requital for this privilege the management will erect permanent structures for the use of the University.

Few business ventures are more elaborate, or require more care in organisation, than one of these modern world's fairs, so that the task is far from being a simple one. In the United States, it is first necessary so to develop the public spirit of the city in which the exhibition is to be held as to command the support of its commercial interests. It is they who must not only furnish the money necessary to lay the foundations to give the scheme a standing place, but from their ranks must be drawn the men who are to manage it in all its various features. In this case, 5,000,000 dols. was raised by local subscriptions in order to meet the demands fixed by the Government, which took its own method of testing the credit and sufficiency of guarantors, the principal of whom were required to give additional assurances as to the trustworthiness of all the subscribers—from whose ranks was chosen a board of directors, 93 in number. These were divided into many committees, each having some special work, and at their head was placed an executive committee upon which the responsibility has mainly fallen.

It was determined at an early stage that the business should be conducted without the usual Director-General, but that the supreme authority should be vested in the president, the executive committee, and four paid officials known as a director of works, to whom the preparation of the grounds and the architecture should be confided; a director of exhibits, who should have full charge of everything relating to the classification and the receipt of exhibits from every part of the world; a director of exploitation, whose function it was to procure legislative or official acceptance of the invitation to take part, from the States and territories of the Union and from foreign countries; and a director of concessions, who had put upon him the duty of arranging for the side shows and attractions which have become such important elements in the modern exhibition. These directors not only have their special duties, but act as advisers or a sort of Cabinet to the President, in deciding matters of policy.

Each of these divisions is divided into departments of which there are about twenty-five in all, managed in each case by a paid chief and qualified assistants. For the most part, directors and chiefs have been chosen from those who have acquired technical experience in the management of previous exhibitions, some of them having had official relations with that held in Philadelphia in 1876. In the main, however, they have been drawn from those who carried on the work at Chicago, in 1893.

The buildings of Washington University, used for administrative purposes, house a working staff of nearly 400 persons, of whom about one-third are typewriter operators.

In perfecting the organisation, it has been necessary for the various committees, often accompanied by prominent men of St. Louis, to visit the capitals of the various States, some of them more than fifteen hundred miles away, there to explain before the Legislatures the features of the exhibition, and to solicit co-operation. This has been done less from the necessity of making appeal in this way than for the more important task of letting the public everywhere know of the preparations under weigh.

In fact the publicity has been not the least important of the features requiring study, organisation, and the utmost care. It was the first necessity to enlist the support of the Press which was done through the various bodies representing it in every branch. They resolved neither to ask nor accept a money return in requital of the effort they proposed to make, but to treat the Exhibition in all its branches and phases, as a matter of purely popular interest. It is not necessary here to expose tricks, said to be inherent in all trades, but it may be asserted with safety that nothing which can form a part of the diverse interests of a great people has been overlooked. There is no State or city for which special news matter has not been prepared; no correspondents, however humble, have been neglected; no feature likely to have a human interest has been overlooked; and no fear of iteration has been allowed to enter into account. The American newspaper writer may be a modest and retiring person when he is seeking news for his paper from individuals, but in his organised efforts to promote a public policy it may be said with truth, that he is little prone to hide his light under a bushel.

One of the most important branches of the exploitation effort was that relating to foreign countries, which naturally were reached, in the first instance, through diplomatic channels. The Government of the United States, after the event had been proclaimed by the President, sent its official invitation, through its ambassadors and ministers, to every country in the world, and issued instructions to all its consular representatives, in order to impress upon them the importance of letting each commercial community know that the Exhibition would be held, and what would be its character and aims. But, as this was not deemed sufficient, commissioners were sent into every quarter of the world under the auspices of the management. In some cases they went from one country to another, now here, now there, but always active in seeing public, responsible officials, leading business men, probable exhibitors and the conductors of the Press. In the United Kingdom, France and Germany, a special commissioner gave his entire attention to a single country. Between these there was a certain amount of friendly rivalry, as to which should secure the earliest and most complete recognition of the Exhibition in the Press. In the last named feature Great Britain has surpassed all the other countries of Europe together, while in the amount of money to be expended and in the variety of exhibits, France and Germany will follow Great Britain in the order mentioned.

It is not extravagant to say that the St. Louis Exhibition has had, during the past three years, something of the character of a new government, recognised as such in every quarter of the globe. Without any formal diplomatic position of its own, its representatives have, nevertheless, gone up and down into the palaces of kings, and the chancelleries of the world, have had the aid of all the ambassadors and consuls of the United States, and, in addition, have been able to command access without pay, to the newspapers, wherever, in our free modern life, these useful educational agents have found development. Within another year this new and vigorous entity will have vanished into nothingness, its representatives will have returned to their own occupations, and, with one exception, its elaborate palaces will soon thereafter be turned over to wrecking companies for dismantlement.

The Exhibition itself will be the latest step in an evolution not alone from all its predecessors—since that marvellous structure in glass which housed so many curious articles and showed the world so many secrets in Hyde-park in 1851—but from that larger course of development which began in the fairs incident to a very early stage in modern commerce. It is interesting to see how the exhibit classifications of an earlier day have remained without serious change beyond that of mere size—now deemed so important. The mechanical devices, formerly shown in the corner of a single building, will now find house and show-room in enormous temporary structures known respectively as the manufactures, the machinery, the liberal arts, the varied industries, the

transportation, and the electricity buildings, with their hundred acres of covered floor space. The Educational Group will not only find room in a building bearing the name of education; but in the Art Building, the Building for Congresses and Conventions, the Physical Culture Building, and the United States Government Building. What may be termed the natural group will be seen in the special buildings—some of them of almost abnormal size—devoted to fisheries, mines and metallurgy, agriculture, horticulture, and forestry, while gardens will be shown in almost endless variety. Games, both ancient and modern, will have a ground of their own, while great races will be run under the auspices of the management.

Classified under the fifteen departments of education, arts, liberal arts, manufactures, machinery, electricity, transportation, agriculture, horticulture, forestry, mines and metallurgy, fish and game, anthropology, social economy, physical culture, each branch of human effort, so far as it can be represented in the form of an object lesson, will be visible, all the countries of the world alongside of each other, each showing its products in its own way. It may be presumed that no country in the world will consent to put anything to the front but what it deems its best. No Government, company, or individual, will be charged for the space which an exhibit will occupy; no duty will be charged for any article intended for display or judgment, and carefully devised systems of internal transportation will enable visitors to see all these accumulated fruits of industry with as little exertion as possible.

Religious, scientific, professional, social and business organisations in almost endless variety, will meet within the grounds sometime during the summer and autumn, nearly two hundred conventions having already been arranged. In addition, amusements of all forms, known and new, will be provided for both children and adults. It would be an almost endless task to enumerate in detail the manifold attractions to be displayed, facilities for which have to be provided. An attempt will be made to show the world in epitome, how it lives, thinks, works, and acts. It seems a wonderful task, and it is, perhaps, not too much to say that the very ability to get together such an aggregation; to raise from thousands of quarters, and to expend the 50,000,000 dols. necessary; to erect for use during a single season, buildings of great size and cost, and of decided architectural merit, will tend to make the general scheme of this Fair, itself the one distinctive feature.

It may not be amiss to say that the bringing together from all the world musical organizations which shall improve the popular taste, without catering too much to its demands, will not be the least of the difficulties which have had to be overcome. The cost of this feature will aggregate a hundred thousand pounds, so expended that the principal countries will be represented by their leading musical organisations—the best they can furnish. It is confidently predicted that the music to be heard at St. Louis next year will exercise a direct, far-reaching influence upon the development of this art in America, as it will everywhere else, by the encouragement thus given to the best the world knows.

The leading element in a great exhibition, in America, as elsewhere, is, and must continue to be, education and art. There is no expectation of a direct profit. All this enormous effort is merely the result of an overflow of energy and public spirit. It is not even certain that it is an immediate material advantage for the city which devotes so much money to its organisation. But it is recognised as a conspicuous element in public taste and the development of variety in industry; most important of all, it brings the peoples of the world into closer relations, and sets a new landmark in the history of mankind as a whole. Too much should not be expected of them. If the dream was once fondly indulged that they would destroy war, this should be succeeded by the reality that they do really tend to promote peace. They are not subjects for rhapsody, but should be seriously considered as gatherings, both social and commercial, to which all peoples of the world come in order to compare notes, and to teach and to learn new lessons. During the past fifty years, this influence, working in co-operation with the achievements of science, and the marvellous advance in material well-being, has made every museum and library cosmopolitan, so that whatever each nation or people may say or endeavour to think, mere nationality fails to satisfy, and, indeed, can no longer do so. While such wholesome results follow, no effort can be too great and no reasonable expenditure too heavy. They have the aim, perhaps unconscious in their organisers and promoters, of breaking down these frowning barriers, both economic and militant, which tend to raise themselves anew at every frontier.

DISCUSSION.

Colonel C. M. WATSON, C.B., said that as he had returned from St. Louis within the last few days, he was able to tell the meeting, from personal observation, something about the progress that had been made with the exhibition. The photographs which had been shown on the screen were interesting, but he could honestly tell them that the buildings themselves were far better than the photographs. The general effect of the exhibition would be one of the most remarkable that had ever been produced. It seemed positively wicked that the buildings should have to be pulled down after the closure of the exhibition, for though they were built only of wood and plaster, they looked as if they were meant to last for a long time. The administrative department of the exhibition was worked on a thoroughly business-like plan. Everyone, from President Francis downwards, seemed to be imbued with the idea of contributing to the success of the great undertaking. There was no red tape, everyone knew what he had to do, and went and did it. They were all aiming to make the greatest show that the world had ever seen. There was, of course, considerable rivalry between the different States, and St. Louis wanted to beat Chicago, and to go, not only one better, but a hundred times better than Chicago went in 1893. In most of the departments the space that had been applied for had been more than double that which the chiefs of the different departments were able to supply. In one sense he was glad that the space required for the exhibits of Great Britain, was greater than the amount that could be obtained. He thought that the Fine Art department which had been organised by a committee, of which Sir Edward Poynter, P.R.A., was the chairman, would give a really good representation of British art. The committee had nearly decided upon the selection of the pictures. In education he believed that the British show would be as good as that in any portion of the exhibition, if not better. In the liberal arts, Great Britain could have put in many more things if space could have been obtained. Dr. Redwood and Mr. Sutherland thought themselves badly used because they could not get more room from the display of the exhibits in chemical industry. British manufactures also could have filled more space, although British exhibitors had many things against them, such as the distance to which their goods would have to be sent, and the high import tariffs. Great Britain would also be well represented in the transport section, the machinery section, and the electrical section. We should have no need to be ashamed of our exhibits.

The Hon. HENRY CLAY-EVANS (United States Consul-General) said that he had been greatly pleased with the entertainment presented to the meeting. He hoped that everyone present would have the pleasure and advantage of visiting the St. Louis Exposition next year. He believed that it would be the greatest that the world had ever seen. They would have an opportunity of comparing the products of the different countries of the world, side by side, within one inclosure. He spent a few weeks at Chicago during the exhibition and he then saw enough to last him for a lifetime. But the representative of Great Britain had just told them that the St. Louis Exhibition was to be a hundred times better than that of Chicago.

Dr. BOVERTON REDWOOD said that he might perhaps be pardoned for saying that he had a feeling almost akin to regret that the very valuable details which had just been placed before them with regard to the forthcoming exhibition, had not been available for the use of some of the committees who had been working for the success of the greatest sections of the exhibition. The organising of exhibits of the chemical and pharmaceutical arts of this country had not been an easy task, and he questioned whether competent persons, would have been found to undertake it, had the exact nature of it been known beforehand. If exceptional facilities had not been granted by the Royal Commission, probably no good result would have been achieved. The sub-committee had been stimulated throughout by a strong feeling that the St. Louis Exhibition would afford an opportunity of giving proof of the estimation in which British manufactures were commonly held abroad, and especially on the continent of Europe. It had been felt that to some extent the character of British chemical exhibits at recent exhibitions justified the somewhat contemptuous attitude of mind which had been entertained towards them on the part of foreign competitors. But the sub-committee felt satisfied that the character of those recent exhibits was simply the outcome of British apathy, and not of British industrial decadence. The sub-committee had set themselves to demonstrate that this country afforded exceptional advantages in the conduct and development of chemical industry. He believed that the exhibits would speak for themselves.

Mr. IMRÉ KIRALFY said that he believed that he was one of the first who saw the plans of the exhibition buildings, and he made some suggestions with regard to them; which had all been accepted. He hoped that the directors of the exhibition would meet with the great success which they so thoroughly deserved.

Mr. JOSEPH PENNELL said that Mr. Parker had not made enough of the point that in the two great exhibitions held in America there was an idea which was, he believed, the outcome of a great conference among artists, architects, builders, and Mr. Kiralfy. The idea was a definite one, and the idea which was carried out at Chicago was that of making the whole exhibition a beautiful picture, and this was carried out successfully. Any spectator standing with his back to the United States building

at the Chicago exhibition, and looking across the great lake at the statue of the Republic gilded by the sunset, saw a picture such as Claude had never imagined, even in his most gorgeous conceptions. He (Mr. Pennell) never realised what a rotten thing photography was for representing such a picture until he saw the photographs which had just been shown on the screen. Those pictures could give no idea of the reality. The feature in one of the photographs which looked like a little filagree was the great source of all the water in the exhibition grounds, backed up by a great pine wood. The various buildings for the electrical department, the educational department, the liberal arts department, and the others were grouped so that they went down like a series of steps one below another. The walk downwards was an easy one, and at the bottom there weıe arrangements for taking people upwards to the higher part. The St. Louis Exhibition would, he believed, form the finest pictorial composition ever made in this world.

The CHAIRMAN said that when he saw the series of very interesting pictures that were thrown upon the screen, the one thought which struck him was the extraordinary debt that America owed to the old world. The inspiration of the whole of the buildings was either French or, to a modified and less extent, English, and the ultimate aspiration of them all was Greek. There was no indication whatever of the Gothic taste, and if American literature, and the general scope of the American genius were examined, this would not be surprising. The genius of the art of Greece was, so to speak, the creation of a master-mind, carried out to a great extent, by people working mechanically under him. Gothic art, on the contrary, was entirely the creation of individual workmen. He noticed in American art a distinct tendency towards the Greek taste. It was a very interesting thing to Europeans to observe the extraordinary way in which all the American ideas in the field of architecture had been taken from the old world. This showed how small, after all, was the inventive power of man. The cathedrals and classical buildings of this country, and of the other countries of Europe were, after all, adaptations of the art of Greece, a small country which, at the time it produced its art, had hardly emerged from barbarism. The thought of the little that modern European nations had been able to add to what had been handed down to them from their ancestors made one feel small. One thing which caused a great deal of trouble in America was the tariff question. Who was going to buy electrical machinery in England if he had to pay 60 per cent. of the value as an import duty upon taking the articles into the United States. No doubt the rest of the civilized world must deplore the fact of the tariffs imposed by the United States. He believed that those tariffs would prove ultimately, disastrous for America. It would be better if agriculture, rather than the industrial arts, was first developed as the basis of trade, and for that reason he regarded a prohibitive tariff as most deplorable. Canada was proceeding on slower lines than the United States in that respect by first developing its agriculture, and would find the advantage of that course. He should be glad if the Americans could see their way to abate their import tariff a little in favour of goods coming to the St. Louis Exhibition, and if the railway companies and hotel keepers would make a substantial reduction in favour of persons residing in Europe visiting the exhibition. It was desirable that as many members of the committees as possible should go over to St. Louis to observe what was to be seen at the exhibition. He did not think that England and the other countries of Europe had ever given a better example of their thorough goodwill to the United States than they had given by the amount of money which they had expended in promoting the coming exhibition, for it must be remembered that tariffs nearly killed European trade, and that England, France, and Germany were likely to gain but very little from the holding of the exhibition.

Mr. G. F. PARKER, in reply, said that he had purposely abstained from saying anything on the point to which Mr. Pennell had alluded, because he knew that Mr. Pennell was coming to the meeting, and would have an opportunity of speaking on it. As to tariffs, the subject was beyond his comprehension, and was certainly beyond his power of discussion. With regard to the cost of reaching St. Louis from different parts, he believed that the railway companies were competing with one another to give the lowest rates from the seashore to that city; and the people of St. Louis had taken in hand the work of preventing extortion being practised upon the visitors. He believed that there would be some assurance that visitors would be fairly treated and not robbed, either on the ocean or on the railways, and that they would get the worth of their money whatever they saw fit to spend.

Miscellaneous.

*THE NEWCOMEN ENGINE.**

A great deal has been written on the steam-engine generally, but the author has not met with any connected record of the invention and construction of the first steam-engine—the atmospheric engine of Newcomen. Unfortunately, it does not appear that very detailed information is available. There are not

* Abstract of a paper read before the Institution of Mechanical Engineers, by Mr. Henry Davey (from *Nature*).

many examples of the engine now in existence, and when they are consigned to the scrap heap, the receptacle of great efforts of the past, all will perhaps be forgotten.

Towards the end of the seventeenth century, philosophers and mathematicians searched for a new method of obtaining motive power. Mining was an important industry requiring in most cases a new power, that the mines might be worked to greater depths. Water-power, where available, was often insufficient, and manual and animal power was altogether too small and too expensive for working any but shallow mines. Deep mining was, and is, only possible with pumping machinery. Water-wheels were used for working pumps. The construction of the common pump was known. Papin had proposed to transmit power by means of pistons moving in cylinders acted on by the atmosphere, a vacuum having been formed under the pistons by the explosion of gunpowder, and he even hinted that it might be done by steam.

It was claimed for Papin that he invented the steam-engine, because in 1685, in one of his letters, he illustrated what was known of the properties of steam by saying that if water was put in the bottom of a cylinder under a piston, and the cylinder be put on a fire, the water would evaporate and raise the piston, and that if, after the piston had been raised, the cylinder were removed from the fire and cooled, the steam would condense and the piston would descend; but this was only an illustration of common knowledge. Sir Samuel Morland had, in 1683, stated* that steam occupied about two thousand times the space of the water from which it was produced, and made some calculations as to the powers to be obtained from different sized cylinders, but suggested no practical mode of operation. An experiment to determine the density of steam was made by John Payne in 1741. Payne concluded, as the result of his experiments, published in the *Phil. Trans.*, vol. xli. p. 821, that one cubic inch of water formed 4,000 cubic inches of steam. Beighton calculated, from an experiment with the Griff engine, the second Newcomen engine erected, that the specific volume of steam was 2893.

The properties of steam were, probably, no better known to philosophers than to the ordinary observer who had seen the lid of a kettle dance under pressure, or steam issue from the spout. The only practical application of steam was made by Savery, who, in 1696, described his invention in a pamphlet entitled "The Miner's Friend." Savery's engine was a pistonless steam pump—in fact, the pulsometer of to-day without its automatic action. It remained for Newcomen to associate the bits of common knowledge in his mind for inventing the steam-engine. He was a blacksmith, probably accustomed to invent methods of construction in the prosecution of his art. At that time mechanics were more self-reliant than they are now. He knew from experience what a lever was, a pump, a piston, a cylinder, a boiler, and he knew that the atmosphere had pressure, and that steam possessed a far greater volume than the water which produced it. It did not require much more than common knowledge and observation to realise that. To produce the steam-engine from such known facts required invention. Philosophers probably knew what might be done, but Newcomen had the advantage of seeing what could be done, and he did it. The engine, when produced, was imperfect, but defects became obvious to the designers and constructors of steam-engines, and the want of perfection at the present day is not from want of theory, but because of practical limitations and want of practical invention.

At this distance of time it is difficult to appreciate the invention required to produce the atmospheric engine from the crude ideas of Papin and others. It appears, from papers in possession of the Royal Society, that Dr. Hooke had demonstrated the impracticability of Papin's scheme, and, in a letter addressed to Newcomen, advised him not to attempt to make a machine on that principle, adding, however, that if Papin could produce a speedy vacuum, his work would be done. A great deal of controversy hangs about this as about all things historical, and little is to be gained by minute research into disputed claims. What we do with certainty know is, that with the common knowledge existing, and the mechanical contrivances available, Newcomen alone succeeded in making a workable engine.

In 1698, Thomas Savery, of London, obtained a patent for raising water by the elasticity of steam.* It is stated in many popular histories that in 1705 Thomas Newcomen, John Cawley, of Dartmouth, and Thomas Savery, of London, secured a patent for "condensing the steam introduced under a piston and producing a reciprocating motion by attaching it to a lever," but no record of such a patent exists in the Patent Office. Stuart gives a list of patents commencing with 1698, and in that list is one said to have been granted in 1705. Dr. Pole, author of "The Cornish Engine," had a search made at the Patent Office and no such record could be found. It is possible that Savery's patent was thought to cover Newcomen's invention (as Savery was associated with Newcomen).† This was sixty-four years before Watt invented his separate condenser. Very little is known of Newcomen. It is recorded that he was a blacksmith or ironmonger residing at Dartmouth, in Devonshire, and that he was employed by Savery to do some work in connection with his water-raising

* See Tredgold's "Steam Engine."

* Savery was born at Shilston, near Modbury, in Devonshire, in 1650; died in London 1715.

† It appears that there is every reason to believe that Newcomen had no patent, and that his invention was supposed to be covered by Savery's patent of 1698, and that the latter was kept in force for thirty-five years, the original patent having been extended for twenty-one years.

engines. In this way he had some experience in the condensation of steam.*

Newcomen appears to have conceived the idea of using a piston for giving motion to pumps. He became associated with John Cawley, a glazier of Dartmouth, probably for business reasons. His connection with Savery was doubtless because of Savery's patent for condensing steam for raising water. He must, however, have been a good mechanic, because the construction of such an engine at a time when there was no previous experience or data to guide him was a task of no ordinary magnitude. He could not get workmen skilful enough to do his work until, erecting an engine near Dudley in 1712, he secured the assistance of mechanics from Birmingham.

The Newcomen engine was soon brought into use, for in 1712 Newcomen, through the acquaintance of Mr. Potter, of Bromsgrove, erected an engine, near Dudley Castle, for a Mr. Back, of Wolverhampton. The cylinder of this engine was surrounded with water. The piston was packed and had a water seal. It is reported that by accident a hole in the piston admitted water into the cylinder, and the condensation thereby became so rapid compared with that produced by cooling the cylinder from the outside that the engine worked much quicker. This may or may not be correct, but it is certain that, by accident or design, the first improvement in the engine was condensation by injection in the cylinder. It appears that the second engine was erected at the Griff Colliery, in Warwickshire, in 1715. It had a 22-inch cylinder. At this time the cocks and valves were all worked by hand, but automatic devices were soon introduced. The first appears to be that of actuating the injection-cock by means of a buoy in a pipe connected to the cylinder. Desaguliers thus describes the apparatus:—"They used to work with a buoy in the cylinder enclosed in a pipe, which buoy rose when the steam was strong and opened the injection and made the stroke." It is said that a boy, Humphrey Potter†, added a catch or "scoggan" which the beam opened, and by this means the speed of the engine was increased from 8 or 10 to 15 strokes per minute.

Among the first erectors of the Newcomen engine were the Hornblowers, in Cornwall. Newcomen visited Mr. Potter, of Bromsgrove, aud erected an engine near Dudley Castle in 1712. This is the historical engine in which injection in the cylinder was first used. In the vicinity lived Joseph Hornblower, an engineer who became acquainted with Newcomen's engine, and who was sent for into Cornwall about 1720 to 1725 to erect an atmospheric engine at Wheel Rose Mine, near Truro.

* Newcomen was born at Dartmouth, about the middle of the seventeenth century, and died in London in 1729. It is stated in Haydn's "Dictionary of Dates" that he was in London trying to secure a patent. A sketch of the house in Dartmouth occupied by Newcomen, when he invented the steam-engine, is shown in a pamphlet published in 1869 for Mr. Thomas Lidstone, of Dartmouth.

† See Stuart's "History of the Steam Engine."

From 1720 to 1740 few engines were erected in Cornwall because of the high duty on sea-borne coal. In 1741, an Act of Parliament was passed for the remission of the duty on coal for fire-engines for draining tin and copper mines in the county of Cornwall. The effect of the passing of this Act was that, by the year 1758, many engines had been brought into use; one engine at Herland had a 70-inch cylinder.

The steam-engine has held its own as a prime mover for two centuries. The gas-engine has now become a more efficient heat-engine, and a powerful competitor, and electricity has become an economical transmitter of power.

Heat, electricity, and mechanical work are mutually convertible. The time may come when heat may be converted into electric current with as little loss as that involved in the conversion of electric current into mechanical work; when that time comes, the heat efficiency of the prime mover will exceed that of the gas-engine in a greater degree than the gas-engine has exceeded that of the steam-engine.

SCOTTISH MINERAL OIL TRADE.

It is a chronic peculiarity of the Scottish mineral oil industry to be prosperous when other trades are dull, and to be unhappy when all other trades are booming. One reason for this is that the main factors in the cost of production by the destructive distillation of oil shale are coal and labour, both of which are apt to be dear in busy commercial times, and *vice-versâ*. But it so happens that at present the Scottish industry is not benefiting particularly by cheap labour, and has, indeed, just come out of a sharp struggle which looked for a time uncommonly like becoming a prolonged labour war. It is true that coal is now comparatively cheap, but the real cause of the prosperity this time is an advance in the prices of its products caused by its own competitors. These competitors are the Standard Oil Company of the United States and the two great producing and exporting oil syndicates of Russia. The Standard Oil Company is probably the wealthiest and most influential industrial organisation in the world, but it cannot control the operations of Nature, as it can the railroad and steamboat companies, and the stream of distribution. It has not been able to prevent a shrinkage in the yield from the Pennsylvania oil wells, which produce not only the best burning oil in America, but which also give forth a crude oil which yields the largest supply of solid paraffin, or "scale," of any of the mineral oils of America. Hence, the Standard Oil Company have had to raise their price for "scale" in the European markets, and latterly to practically retire from the British markets, which they have been accustomed to divide (on their own terms) with the Scotch paraffin oil makers. Therefore, the Scotch companies have been enabled to get a large advance upon last year for their wax, or "scale"—

which is used for candle-making and match-making chiefly—and will probably get a still further advance before the oil year expires at March 31st next.

The Pennyslvanian mineral oil is practically the only competitor the Scotch companies have in this product. The other mineral oils of America yield only a small proportion of this solid material, and the Russian natural oils do not yield it at all. But the Russian companies are the chief competitors of the Scotch companies in the sale of lamp oil in the British Isles. Once upon a time it was American petroleum that drowned out Scottish paraffin oil. Nowadays it is Russian oil that rules our markets, especially in Ireland and Scotland. And the competition between the two great Russian syndicates to obtain the sole control of these markets has during the last year or two depressed the price of burning oil to a point unremunerative to the Scotch companies, who distil it not from natural oil, but from a mineral substance like slatey coal. The Russian companies are now tired of this profitless competition. Last week the export price at Baku was raised by eight kopecks per pood, and crude naphtha was raised to ten kopecks, on account of the restricted output. During the first nine months of this year the yield was about 20 million poods less than in the corresponding period of last year, and it has been still further reduced by the stoppage of a number of wells which are the subject of litigation. Following upon this the Caucasian Petroleum Export Company have advanced the price of their lamp oil to 6d. per gallon delivered in this country. Selling upon this basis the Scotch companies will obtain fully one halfpenny per gallon more for their paraffin (burning) oil than they did last year. They will not get this advance for the whole season's make, because the contract season begins in August, and no doubt some contracts have been made for winter delivery at the old price. But the companies were not eager sellers, because they were looking for an advance in Russian oil, and also because in September and October they were in the midst of a wages dispute with their shale miners which threatened to suspend the whole industry for an indefinite period. These men who mine the shale on which the whole industry depends, claimed not only an advance in wages (and they were already earning about a shilling a day more than their fellow-workers in the adjacent and more hazardous coal pits), but to be rated hereafter in relation to the fortunes of the oil industry, and not as miners. To this the oil companies could not consent, because there is but one labour market in so far as mining is concerned in Scotland, and to make a new market for shale miners would be, in the long run, as disadvantageous to the men as to the employers. A general strike was only averted by a reference of the claim of the shale miners for an advance to the arbitration of Sheriff Jameson, and the case is still awaiting his decision as we write. Into the merits of the dispute we need not enter just now. Suffice it that a very disastrous strike has been averted at a time when the fortunes of the Scotch oil companies are more promising than they have been for many years.

The advantage to be gained in paraffin oil from the advance in Russian petroleum is to a large extent prospective. But in another respect Russia competes with Scotland, and that is in certain qualities of heavy oils used for machinery and lubricating purposes. These oils were held down all last year by the fierce competition of two Russian syndicates, but this year these syndicates have come under a compact not to sell under certain fixed standard rates. On the basis of this arrangement the Scotch companies are, and have been for some time, receiving about 30s. per ton more than last year for their production of this particular class of oils. In other classes of heavy oils the chief competitor of the Scotch companies is the Standard Oil Company of America. But these oils of the Standard Company are extracted mainly from the crude oil of the Pennsylvania wells, and are, consequently, reduced by the shortage of those wells. Hence the Standard Company have had to restrict their sales and raise their prices, so that on their production of equivalent oils, the Scotch companies are obtaining about 40s. per ton more than last year. In naphtha, another important product, an advance of about ½d. per gallon is being realised. In sulphate of ammonia, of which the Scotch oil companies make a great deal, but of which neither the American nor the Russian companies are producers, an advance was being obtained earlier in the season of first £1 15s. and then £1 per ton over the agerage of last year. The price is now down again to about the average, but the net results of the current year in this item must show a considerable improvement on last year.

On the whole, with the higher prices which are being realised for the principal products, the Scotch oil companies should be able, when the accounts are made up in March and April next, to show an increase of fully £200,000 in the year's earnings. They will doubtless also be able to show some further savings in the costs of manufacture, but not very much need be expected under this heading, because during the past two or three years all the resources of their scientific attainments and technical experience have been taxed to the utmost in order to make ends meet under low markets. But some appreciable saving should be effected in coal and in general material. On the other hand, labour is even now costing as much as last year, and is more likely to be higher than lower as the oil year advances. There are fully four months of the oil year yet to run, and, of course, much may happen in that time, but from present appearances one may count both on larger dividends and on material improvement in the financial and industrial condition of the companies when accounts are next squared. The prospect is, indeed, so good that there is now a project to reconstruct the long derelict and never very prosperous Burntisland Oil

Company across the Forth from Leith. It is to be hoped, however, that there will be no undue haste in reviving shipwrecked oil concerns. The industry has suffered too much in the past from both under and over capitalisation, and it can easily be squeezed out of existence altogether by a combination of American and Russian producers.—*The Economist.*

Obituary.

RIGHT HON. CHARLES SEALE-HAYNE, M.P.—Mr. Seale-Hayne, who died of apoplexy on Sunday morning, 22nd inst., was a member of the Society of Arts since 1869. He was born at Brighton in 1833, educated at Eton, and called to the bar in 1857. In 1865 he was elected Liberal member for the Mid or Ashburton Division of Devonshire, which he continued to represent until his death. In 1892 he obtained the office of Paymaster-General, and was created a Privy Councillor. He was treasurer of the Cobden Club, in which organisation he took an active interest. He also took a prominent part in the affairs of Devonshire. He was the first chairman of the Dartmouth and Torbay Railway, and was also a director of the South Devon Railway Company before its acquisition by the Great Western Railway. In 1870 he wrote a letter on Railway Reform, which was printed in the Society's *Journal* (vol. xviii., p. 697).

MEETINGS OF THE SOCIETY.

Wednesday Evenings, at 8 o'clock :—

DECEMBER 2.—"Fiscal Reform." By SIR CHARLES MALCOLM KENNEDY, K.C.M.G., C.B. SIR GEORGE BIRDWOOD, K.C.I.E., C.S.I., will preside.

DECEMBER 9.—"Furnaces suitable for Jewellers' Work, Enamelling, Art Casting, and other similar Industries." By HENRY HARDINGE CUNYNGHAME, C.B. PROF. C. V. BOYS, F.R.S., will preside.

DECEMBER 16.—"The Science of Taxation and Business." By SIR WILLIAM HENRY PREECE, K.C.B., F.R.S. SIR ROBERT GIFFIN, K.C.B., LL.D., F.R.S., will preside.

INDIAN SECTION.

DECEMBER 10 (4.30 p.m.).—"India's Place in an Imperial Federation." By J. M. MACLEAN. SIR EDWARD A. SASSOON, Bart., M.P., will preside.

APPLIED ART SECTION.

DECEMBER 15 (8 p.m.). — "The British Silk Industry," by FRANK WARNER. SIR THOMAS WARDLE will preside.

Papers for Meetings after Christmas :—

"Ice Breakers and their Services." By ARTHUR GULSTON.

"Lessons to be Learnt from the Fire Brigade Appliances at the late International Fire Exhibition." By EDWIN O. SACHS.

"Organ Design." By THOMAS CASSON.

"Mahogany and other Fancy Woods available for Constructive and Decorative Purposes." By FRANK TIFFANY.

"Artificial and other Building Stones." By L. P. FORD.

"Thermit." By PROF. CHARLES VERNON BOYS, F.R.S.

"Steam Motors." By THOMAS CLARKSON, M.I.Mech.E.

"Early Painting in Miniature." By RICHARD R. HOLMES, C.V.O.

"Mechanical Piano Players." By J. W. COWARD.

"The Presidency of Bombay." By SIR WILLIAM LEE-WARNER, K.C.S.I.

"Agricultural Education." By J. C. MEDD.

"Garden Cities." By A. R. SENNETT.

INDIAN SECTION.

The meetings of this Section will take place on the following Thursday afternoons at 4.30 o'clock :—

December 10, January 11, February 11, March 10, April 28, May 12.

COLONIAL SECTION.

The meetings of this Section will take place on the following Tuesday afternoons at 4.30 o'clock :—

February 2, March 1, April 12, May 3.

APPLIED ART SECTION.

The meetings of this Section will take place on the following Tuesdays at 4.30 or 8 o'clock :—

December 15, January 19, February 16, March 15, April 19, May 17.

CANTOR LECTURES.

The following courses of Cantor Lectures will be delivered on Monday evenings, at 8 o'clock :—

BENNETT H. BROUGH, "The Mining of Non-Metallic Minerals." Four Lectures.

LECTURE II.—NOVEMBER 30.—*Salts :* — Rock-salt — Potash salts — Borates—Alums — Nitrates—Phosphates.

LECTURE III. — DECEMBER 7.—*Stone :*—Flint, Sandstone — Limestone — Marble — Dolomite — Slate — Eruptive rocks — Mica — Clays—Gypsum—Asbestos—Bauxite—Other earthy minerals.

LECTURE IV.—DECEMBER 14.—*Precious Stones :* —Diamond — Corundum Gems — Emerald — Other Precious Stones—Ornamental Stones—Rare Earths.

J. LEWKOWITSCH, PhD., M.A., F.I.C., "Oil and Fats—their Uses and Applications." Four Lectures.
January 25, February 1, 8, 15.

CHARLES T. JACOBI, "Modern Book Printing." Two Lectures.
February 22, 29.

BERTRAM BLOUNT, F.I.C., "Recent Advances in Electro Chemistry." Three Lectures.
March 7, 14, 21.

The following course will be delivered on Monday afternoons, at 4.30 o'clock :—

PROF. R. LANGTON DOUGLAS, M.A., "The Majolica and Glazed Earthenware of Tuscany." Three Lectures.
April 25, May 2, 9.

JUVENILE LECTURES.

Two lectures, suitable for a juvenile audience, will be delivered on Wednesday Evenings, January 6 and 13, 1904, at 5 o'clock, on "Navigation of the Air," by ERIC STUART BRUCE, M.A.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, Nov. 30...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lecture.) Mr. Bennett H. Brough, "The Mining of Non-Metallic Minerals." (Lecture II.)

Engineers, in the Theatre of the United Service Institution, Whitehall, S.W., $7\frac{1}{2}$ p.m. Mr. Albert Gay, "Mechanical Stokers for Electricity Generating Stations."

Actuaries, Staples-inn Hall, Holborn, 5 p.m.

Camera Club, Charing-cross-road, W.C., $8\frac{1}{4}$ p.m. Mr. J. Spottiswoode, "Modern Methods of Reproducing Half-tone Blocks for Illustration."

London Institution, Finsbury-circus, E.C., 5 p.m. Prof. J. Garwood, "Volcanoes, with special reference to the recent Eruptions."

TUESDAY, DEC. 1...Sanitary Engineers, 19, Bloomsbury-square, W.C., 7 p.m. Mr. H. Harcourt Verden, "Sanitary Law."

Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Discussion on Dr. Hugh Robert Mill's paper, "The Distribution of Mean and Extreme Annual Rainfall over the British Isles."

Pathological, 20, Hanover-square, W., $8\frac{1}{2}$ p.m.

Zoological, 3, Hanover-square, W., $8\frac{1}{2}$ p.m. 1. Mr. F. R. Beddard, "Note upon the Tongue and Windpipe of the American Vultures, with Remarks on the Inter-relations of the Genera *Sarcorhamphus*, *Gypagus*, and *Cathartes*." 2. Miss Dorothy M. A. Bate, "The Mammals of Cyprus." 3. Dr. R. N. Salaman, "The Cause of Death of a Polar Bear recently living in the Society's Gardens."

WEDNESDAY, DEC. 2...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Sir Charles Malcolm Kennedy, "The Fiscal Problem."

Geological, Burlington house, W., 8 p.m.

Entomological, 11, Chandos-street, W., 8 p.m.

Royal Archæological Institution, 20, Hanover-square, W., 4 p.m.

Obstetrical, 20, Hanover-square, W., 8 p.m.

THURSDAY, DEC. 3...Aeronautical, at the HOUSE OF THE SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. 1. Report of the International Kite Competition. 2. Professor G. H. Bryan and Mr. W. E. Williams, "The Longitudinal Stability of Aeroplane Machines." 3. Mr. William Marriott, "The Balloon Ascents made by the late Mr. James Glaisher, for Scientific Purposes." 4. Mr. William Cochrane, "The Mechanical Imitation of Bird Flight."

Royal, Burlington-house, W., $4\frac{1}{2}$ p.m.

Antiquaries, Burlington-house, W., $8\frac{1}{2}$ p.m.

Linnean, Burlington-house, W., 8 p.m. 1. Dr. Arthur Willey, "Littoral Polychæta from the Cape of Good Hope." 2. Miss May Rathbone, "Notes on *Myriactis Aresdrongii* and *Coilodesme Californica*."

Chemical, Burlington-house, W., 8 p.m. 1. Mr. J. F. Bottomley, "The Molecular Formulæ of some fused Salts as determined by their Molecular Surface Energy." 2. Mr. R. C. Farmer, "Acid Salts of Monobasic Acids." 3. Mr. G. T. Moody, "The Atmospheric Corrosion of Zinc." 4. Messrs. B. D. Steele and F. M. G. Johnson, "The Solubilities of the Hydrates of Nickel Sulphate."

London Institution, Finsbury-circus, E.C., 6 p.m. Mr. J. M. Bacon, "Balloons and Flying Machines."

Civil and Mechanical Engineers, Caxton-hall, Westminster, S.W., 8 p.m. Mr. J. Bridges-Lee, "The Photographic Camera as an Instrument of Exploration, Record, and Measurement."

National Indian Association, Jehanghir Hall, Imperial Institute-road, S.W., 4 p.m. Dr. John Pollen, "An International Language, or Esperanto."

FRIDAY, DEC. 4...Civil Engineers, 25, Great George-street, S.W., 8 p.m. (Students' Meeting.) Mr. W. H. A. Robertson, "Artificial Draught, as applied to Fans to Steam-Boilers."

Art Workers' Guild, Clifford's-inn Hall, Fleet-street, E.C., 8 p.m. Annual General Meeting. Paper on "Bewick."

Architectural Association, 9, Conduit-street, W., $7\frac{1}{2}$ p.m. Lecture "Photography for Architects."

Geologists' Assoc., University College, W.C., 8 p.m. The President, "Land, Freshwater, and Estuarine Deposits," with special reference to recent excursions.

Quekett Microscopical Club, 20, Hanover-square, W.C., 8 p.m.

Journal of the Society of Arts.

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FRIDAY, DECEMBER 4, 1903.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

NEXT WEEK.

MONDAY, DECEMBER 7, 8 p.m. (Cantor Lecture.) BENNETT H. BROUGH, "The Mining of Non-Metallic Minerals." (Lecture III. Stone.)

WEDNESDAY, DECEMBER 9, 8 p.m. (Ordinary Meeting.) H. H. CUNYNGHAME, C.B., "Furnaces suitable for Jewellers' Work, Enamelling, Art Casting, and other similar Industries."

THURSDAY, DECEMBER 10, 4.30 p.m. J. M. MACLEAN, "India's Place in Imperial Federation."

CANTOR LECTURES.

Mr. BENNETT H. BROUGH delivered the second lecture of his course on "The Mining of the Non-Metallic Minerals," on Monday evening, the 30th ult.

The lectures will be printed in the *Journal* during the Christmas recess.

JUVENILE LECTURES.

The usual short course of lectures adapted for a juvenile audience will be delivered on Wednesday afternoons, January 6th and 13th, at 5 o'clock, by ERIC STUART BRUCE, M.A., on "Navigation of the Air."

Each member is entitled to a ticket admitting two children and an adult.

A sufficient number of tickets to fill the room will be issued to members in the order in which applications are received.

Members who desire tickets for the course are requested to apply for them at once.

Proceedings of the Society.

THIRD ORDINARY MEETING.

Wednesday, December 2, 1903; SIR GEORGE BIRDWOOD, K.C.I.E., C.S.I., LL.D., M.D., Vice-President of the Society, in the chair.

The following candidates were proposed for election as members of the Society:—

Acker, Charles E., Acker Process Company, Niagara Falls, New York, U.S.A.
Baldwin, Harold O., 3, Blurton-road, Fenton, Staffordshire.
Furse, Captain A. D., Glenwood, Chelverton-road, Putney, S.W.
Gauntlett, Paul E., 6, Rood-lane, E.C.
Green, George, J.P., Methven, Balshagray-avenue, Partick, Glasgow.
Ham, Frederic George Sison, A.M.I.Mech.E., 13, Grosvenor-road, Westminster, S.W.
Hills, David, Rosetta, Brackley-road, Beckenham, and 2, Bayer-street, Golden-lane, E.C.
O'Neill, James Joseph, M.I.N.A., 19, Roxburgh-street, Hillhead, Glasgow.
Wall, Frank, Globe Works, Grays, Essex.
Williams, Alfred, 13, Hillcroft-crescent, Ealing, W.

The following candidates were balloted for and duly elected members of the Society:—

Adcock, Cecil Philip, Via Marco Minghetti, Galleria Sciarra, Rome, Italy.
Allbless, Edalji Dossabhoy, 4C, Patel-street, Fort, Bombay, India.
Allen, Raymond Cecil, Chief Surveyor, Uganda, British East Africa.
Anaman, Rev. Jacob Benjamin, Anamaboe, Gold Coast, West Africa.
Anderson, Ralph W., Government Offices, Bloemfontein, Orange River Colony, South Africa.
André, Eugene, Trinidad Union Club, Trinidad, British West Indies.
Archer, William Henry, New Gas Works, Cromer.
Ashpitel, Francis Wm., Assoc.M.Inst.C.E., Eastfield-lodge, Guildford.
Baker, Thomas Summers, Hong Kong and Shanghai Bank, Yokohama, Japan.
Bakewell, William Whitehorn, Dilwyn, Manor-road, St. Alban's.

Barham, Charles James, The Elms, Erith.
Bass, John Foster, LL.B., 189, La Salle-street, Chicago, Ill., U.S.A.
Baumann, Paul A., Kenmore, The Bishop's-avenue, Hampstead-lane, N.
Bayldon, Edward Herbert, J.P., Oaklands, Dawlish, Devon.
Beatty, John W., M.A., Carnegie Institute, Pittsburgh, Pennsylvania, U.S.A.
Beaumont, Eugene C., 78, Fleet-street, E C.
Bentley, Mrs. Royds, Lochcote, Linlithgow, N.B., and West Bilney Hall, King's Lynn.
Bevan, Charles Lewis Huzzard, 19, Bouverie-road West, Folkestone.
Blagden, Arthur H., A.M.I.E.E., Electricity Department, Municipal Council, Shanghai, China.
Botwood, Charles Walker, D.Sc., Ph.D., 74, Micklegate, York.
Bower, Tom H. V., M.Am.I.M.E., 6, Salisbury-house, London-wall, E.C.
Bradburn, Albert Edwin, 19, King Edward-street, Macclesfield.
Bradford, Frank, A.M.I.E.E., 17, Denman-drive, Newsham-park, Liverpool.
Bradford, Henry, 51, Welbeck-street, W.
Bradley-Birt, Francis Bradley, Gobindpur, Manbhum, Chota Nagpore, India.
Britton, Sydney E., A.M.I.E.E., A.M.I.Mech.E., Electricity Works, Motherwell, N.B.
Broom, George Henry, the Technical College, Huddersfield.
Brown, James Clifford, 20, Lewin-road, Streatham-common, S.W.
Brown, John Armour, Moredun, Paisley, N.B.
Calvert, Edward, Electricity Works, Squires'-lane, Finchley, N.
Carpenter, Henry Cort Harold, the National Physical Laboratory, Bushey-house, Teddington.
Carter, Alfred, Sanitary Board Offices, Hong Kong.
Cates, Mrs. Arthur, 12, York-terrace, Regent's park, N.W.
Chesher, Rev. Ernest William, 8, St. Alban's-road, Swansea.
Chinoy, Phirozshaw Ardeshir, 9, Hornby-row, Fort, Bombay, India.
Christian, Edward A., 12, The Woodlands, Clifton-park, Birkenhead.
Clulow, George, 51, Belsize-avenue, N.W.
Cofman-Nicoresti, J., 41, Hart-street, W.C.
Converse, C. Crozat, LL.D., Highwood, Bergen County, New Jersey, U.S.A.
Cowan, Lieut.-Col. James Henry, R.E., Roxburgh, Vanbrugh Park-road west, Blackheath, S.E.
Cowan, Percy John, A.M.I.Mech.E., 10, Buckingham-street, Strand, W.C.
Coyle, Daniel, M.I.E.E., 63, Warwick-street, Belgrave road, S.W.
Craddock, Arthur R., A.I.E.E., Canterbury College, Christchurch, New Zealand.
Crittall, Richard, 27, Noel-street, Wardour-street, W.
Cullen, Percy, Fort Johnston, British Central Africa.
Cushing, Rev. J. N., Baptist College, Rangoon, Burma.
Darlington, Latimer, D.C.L., Consul de Belgique, Bradford.
Davies, George Thomas, A.M.I.E.E., 10, Sion-hill, Clifton, Bristol.
De Carteret, Captain William George Squares, P.O. Box 456, Halifax, Nova Scotia, and The Pines, Beer, near Seaton, Devonshire.
Deerr, Noël, Beau Champ G.R.S.E., Mauritius.
Defries, Miss Violet, 18, Elgin-crescent, Notting hill, W.
Deutschberger, Rev. S. J., B.A., 266, Dalston-lane, Lower Clapton, N.E.
Dobson, William Henry, Standerton Heath Board, P.O. Box 66, Standerton, Transvaal, South Africa.
Donnithorne, Harold Edward, A.M.I.E.E., 76, Queen's-gate, S.W.
Du Bois, Patterson, care of Frau Dr. Harrass, Laves Strasse 73I, Hannover, Germany.
Dunbar-Anderson, Kingsley, M.I M.E., M.I. Mech.E., The Bungalow, Pretoria-street, Hospital-hill, Johannesburg, South Africa.
Dwyer, Feargus, The Residency, Kontagora, Northern Nigeria, West Africa.
Eckersley, James, 80, Gloucester-place, Portman-square, W.
Edwards, Walter Moorcroft, Luipaardsvlei, Krugersdorp, Transvaal, South Africa.
Ermen, George, A.M.I.Mech.E., Messrs. George Wragge, Ltd., 152–156, Chapel-street, Salford, Manchester.
Fairweather, Wallace Cranston, M.A., 65 and 66, Chancery-lane, W.C.
Faulkner, Arthur, The Gables, St. Peter's-park, St. Alban's, Herts.
Fenning, Edward George, 5, Briarwood-road, Clapham, S.W.
Fitzwilliam, Leo D., Edward-street, Princes-town, Trinidad, British West Indies.
Fowler, Thomas Benjamin Davis, 441, Bartolomé Mitre, Buenos Aires, South America.
Fraser, S. E., Waikino, Waihi, New Zealand.
Garnett, Herbert, A.M.I.Mech.E., Maghery, Moy, Co. Tyrone.
Gerothwohl, Maurice Alfred, 94, Redcliffe-gardens, S.W.
Good, George Lacy, M.Inst.C.E., Cape Government Railways, Kri-road, Cape Colony, South Africa.
Gott, Alfred Thomas, 191, Horton-road, Bradford, Yorks.
Gradinger, E. C., Y.M.C.A. Buildings, Madras, India.
Grantham, Richard Fuge, M.Inst.C.E., 23, Northumberland-avenue, W.C.
Grey, W. H., Lagos, West Africa, and Junior Athenæum Club, W.
Griffiths, Manfred E., "Fernside," Stowmarket.
Gunner, Charles E., Mansion-house-chambers, 20, Bucklersbury, E.C.
Haff, Max M., 138, Slater-street, Ottawa, Canada.

Hajibhoy, Mahomed, Aden.
Halden, J., The Woodlands, Ellesmere-park, Eccles, Lancs.
Hallett, Joseph, M.I.N.A., 108, Fenchurch-street, E.C.
Hamilton, James Henry, A.M.I.E.E., 18, Canterbury-street, Belfast.
Harding, Walter Ambrose Heath, F.Z.S., Histon-manor, Cambridgeshire.
Harpur, Reginald Charles, A.M.I.E.E., Electric Light Station, Dover.
Hartley, Sir Charles Augustus, K.C.M.G., M.Inst. C.E., 26, Pall-mall, S.W.
Hawkins, Henry, Leeming-hall, Todmorden.
Head, James, J.P., 40, Lowndes-square, S.W., and Inverailort, Fort William, N.B.
Healy, Louis Thomas, A.I.E.E., 20, Linton-street, Islington.
Henderson, Donald D., A.M.I.Mech.E., Jamaica-buildings, St. Michael's-alley, Cornhill, E.C.
Henderson, Horace W., Tramway Power House, Cork.
Holcombe, Hon. Chester, Newark, Wayne County, New York, U.S.A.
Hughes, Miss Emily, 22, Market-street, Brighton.
Isherwood, Oswald, F.C.S., 6, Hardy-street, Peel-green, Patricroft, near Manchester.
Iyya, N. V., 48, Coral Merchant-street, Muthialpet, Madras, India.
Johnston, Charles, Assoc.M.Inst C.E., Assistant-Engineer, P.W.D., Begari Canals, Jacobabad, India.
Jones, Frederick Malcolm Hurdis, 90, Holland-road, Kensington, W.
Jones, Thomas, M.Inst.C.E., M.I.M.E., 1, Princes-street, Westminster, S.W.
Kahler, William Ross, 24A, Nanking road, Shanghai, China.
Keeves, J. H. Thomas, 14, Highbury-terrace, Highbury, N.
Kersey, Walter Robert, 52, Gracechurch-street, E.C.
Kershaw, George Bertram de Betham, Ingleside, West Wickham, Kent.
Knight, Charles Crosby, 10, Pembury-road, Tottenham, N.
Laffère, Richard Lawson, Assoc.M.Inst.C.E., Taiping, Perak, Federated Malay States.
Laidlaw, Robert, Bonchester, Chislehurst.
Lawson, William, 99, Crescent-road, Middlesbrough.
Leah, Samuel Dawson, 18, Applegarth-road, Brook-green, W.
Lilley, George Charles, 146, Stapleton Hall-road, Stroud-green, N., and 10, London-street, Fenchurch-street, E.C.
Lindholm, O. W., Vladivostock, Siberia.
Low, A. Maurice, 1410, G.-street, Washington, D.C., U.S.A.
Lowber, James William, M.A., D.Sc., Ph.D., LL.D., 113, East 18th street, Austin, Texas, U.S.A.
McClelland, James, 3, Custom House-square, Belfast.
McConnell, William Dunbar, 64, Burma-road, Clissold-park, N.
McDonald, James, 57, Cadogan-square, S.W.
Mackinlay, James Tennant Caird, Kinning-park Smelting Works, Glasgow.
McMahon, John Joseph, A.M.I.Mech.E., Corporation Tramways, 55, Piccadilly, Manchester.
Magoun, Professor Herbert William, Ph.D., M.A., Redfield, South Dakota, U.S.A., and Alewive, Maine, U.S.A.
Malloch, William Farquhar, Town Office, Uitenhage, Cape Colony, South Africa.
Mamede, Dr. Ceciliano, Pernambuco Water Company, Pernambuco, Brazil, South America.
Marin, Don Estéban, Rosales 10, Madrid, Spain.
Marriott, T. Bruce, F.I.C., The Himan Concessions, Ltd., Bogosu, via Tarkwa, Sekondi, West Africa.
Martin, Edward, 4, Vine-street, York-road, Lambeth, S.E.
Marx, Robert J., 133-139, Finsbury-pavement, E.C.
Mehta, Sorab Bomanjee, Bombay, India.
Meikle, John, Messrs. Meikle Bros., Umtali, Rhodesia, South Africa.
Messervy, Henry, British Guiana Diamond Syndicate, Ltd., Georgetown, Demerara, British Guiana.
Meyrick-Jones, Leonard Meyrick, A.M.I.Mech.E., Wroxham, Norwich.
Michaux, Daniel, A.R.S.M., The Van Ryn Gold Mines Estate, Ltd., P.O. Benoni, Transvaal, South Africa.
Minifie, Rev. William C., D.D., The Retreat, Clytha park, Newport, Mon.
Mole, Walter, F.R.G.S., The Memorial Hall, Farringdon-street, E.C., and Syltorvan, Cheshunt, Herts.
Moore, George, M.Inst.C.E., care of Manila Railway Co., Ltd., Manila, Philippine Islands.
Moore, Robert Thomas, 142, St. Vincent-street, Glasgow.
Morgan, Gwyn Vaughan, 1, St. James'-place, S.W.
Morrell, George Henry, 29, Fermoy-road, Maida-hill, W.
Morriss, Job S., 57-59, Ludgate-hill, E.C.
Muller, A., Messrs. Henry Maurer and Son, 420 East 23rd-street, New York City, U.S.A.
Neher, Clemens, 29, Nottingham-place, Marylebone, W.
Nelson, Major John Yeates, M.I.E.E., Postal and Electric Telegraph Dept., General Post Office, Sydney, N.S.W., Australia.
Newton, William M., 96, Wood-street, E.C.
Norman, Frederick Charles, F.S.S., Cranleigh, Egham, Surrey.
Norton, Captain John Smedley, 3, Remenham Hill-terrace, Henley-on-Thames.
O'Meara, Major Walter Arthur John, R.E., C.M.G., Simla-lodge, Sunbury.
Patel, Munchershaw J., Bombay, India.
Patey, Arthur Pettman, A.M.I.E.E., Resident Engineer, Houses of Parliament, Westminster, S.W.
Pearson, James Davis, Assoc.M.Inst.C.E., G.K. Railway, Barano P.O., *viâ* Giridih, Hazaribagh District, India.

Pearson, Captain William McMullen, I.M.S., care of Messrs. Thomas Cook and Son, Bombay, India.

Perez, George Victor, M.B., M.R.C.S., Puerto Orotava, Tenerife, Canary Islands.

Perryman, Charles Wilbraham, J.P., 41, Charing-cross-road, W.C.

Petherbridge, R. C., The Kinta Association, Ltd., Tanjong Rambutan, Perak, Federated Malay States.

Pope, Reginald, A.R.I.B.A., 17, Cheriton-place, Folkestone.

Pope, William Waller, M.I.Mech.E., Hatfield, The Grove, Slough.

Price, Albert Edward, A.M.I.Mech.E., Cleveland Works, Wolverhampton.

Pries, Robert, A.I.E.E., 82, Bunhill-row, E.C.

Pring, Francis E., A.I.E.E., Hazel Dene, Ty Maur-road, Llandaff Station, Cardiff.

Ramsell, A., 187, Wolverhampton-st., Dudley, Worcs.

Rao, Mangalore Basti Subha, B.A., Superintendent, Observatory, Hyderabad, Deccan, India.

Reade, John, F.R.S.C., 270, Laval-avenue, Montreal, Canada.

Richardson, Major Edwin Hautonville, Panbride, Carnoustie, Forfarshire, N.B.

Ross, Charles Edmonstone, Chepauk, Madras, India.

Rowbotham, James McKean, M.Inst.C.E., Calle Corrientes, 951, Buenos Ayres, South America.

Rutson, Mrs. Mary E., 74, Eaton-square, S.W.

Salimollah, Hon. Nawab, Bahadur, Dacca, Eastern Bengal, India.

Salmon, A. E., South African Art Gallery, Cape Town, South Africa.

Samuel, Hon. Jacob Henry, Government Secretariat, Abeokuta, *viâ* Lagos, West Africa.

Sanders, Carl, care of Messrs. Hatton and Cookson, Ltd., Chiloango, Landana, Portuguese Congo.

Scrutton, T. C., The Borneo Company, Ltd., Bidi, Sarawak, Borneo.

Silver, Hugh Christopher C. C., 23, Redcliffe-square, South Kensington, S.W.

Simpkin, Frank Henry, A.M.I.Mech.E., 159, Firth-park-road, Sheffield.

Smart, Miss Mary A., 31, Shandon-road, Clapham-common, S.W.

Smith, Albert, A.I.E.E., 54, Hounds-gate, Nottingham.

Smith, Oberlin, M.Am.Soc.C.E., Ferracute Machine Co., Bridgeton, New Jersey, U.S.A.

Snow, Andrew Waugh, 2, Culford - gardens, Cadogan-gardens, S.W.

Spicer, H. Norman, P.O. Box 123, Kalgoorlie Western Australia.

Spindler, Vyvyan, Kenmore-house, Middle-street, Port Elizabeth, Cape Colony, South Africa.

Spoor, James Lockhart, Portinscale-house, East Putney, S.W., and 8–12, Brook-street, Hanover-square, W.

Starnes, Herbert S., Avenue-corner, Crook Log, Bexley-heath, Kent.

Stevenson, John L., 39, Victoria-street, Westminster, S.W.

Tasker, Edward Ernest, 59, Lennard-road, Penge, S.E.

Tate, Harry Russell, Fort Hall, Nairobi, Mombasa, British East Africa.

Templeton, William S., M.A., B.Sc., Royal Indian Engineering College, Cooper's-hill, Surrey.

Thomas, Captain F. W., 150, Gloucester-terrace, Paddington, W.

Thomson, William Charles, 33, Castle-street, Cape Town, South Africa.

Trinham, James Samuel, The Waverley Iron and Steel Co., Ltd., Coatbridge, N.B.

Trower, Percy Bence, 39, St. Mary-at-Hill, E.C.

Ullyet, Reginald Heber, M.I.M.E., P.O. Box 5283, Johannesburg, Transvaal, South Africa.

Unna, Alfred Ernest, Royal Palace Hotel, Kensington, W.

Viccajee, F. K., F.C.S., H.H. The Nizam's Mint, Hyderabad, Deccan, India.

Wade, Charles H. Stuart, J.P., Fort Edmonton. Alta, Canada.

Wagner, Felix, 1, Hamilton-road, Highbury-park, N.

Wakelin, John Frederick, 5, Tottenham-street, Tottenham-court-road, W.

Waldron, Derwent Hutton Ryder, M.B., Senior Medical Officer, Elmina Castle, *viâ* Cape Coast, Gold Coast Colony, W. Africa.

Walker, William Izett, A.M.I.E.E., 133, George-street, Edinburgh, and Greenfield, Tollcross, Glasgow.

Warner, Frank, 3 and 4, Newgate-street, E.C.

Webster, John, M.Am.I.M.E., Houtpoort, Ltd., Heidelberg, Transvaal, South Africa.

Westall, George, 87, Chancery-lane, W.C.

Weston, Maximillian John Ludwick, A.I.E.E., 57, Argyle-street, Birkenhead.

Wheeler, George, 64, South-park, Canonbury, N.

Wheelwright, J. B., 16, Burmester's-buildings, Adderley-street, Cape Town, South Africa.

Whensa-Nicholl, Charles, B.Sc., A.M.I.E.E., 33, Hamlet-gardens-mansion, Ravenscourt-park, W.

Williams, John R., A.M.I.E.E., 72 Burngreave-road, Sheffield.

Willis, William, 36, Frances-road, Windsor.

Winebloom, Albert Victor, A.M.I.Mech.E., 84, Savernake-road, Hampstead, N.W.

Wodson, T. W., Old Deer Park, Gardens, Capetown, South Africa.

Woodbridge, Samuel Homer, Massachusetts Institute of Technology, Boston, Mass., U.S.A.

Woodhouse, Lister, A.C.A., Westminster City Hall, Charing-cross-road, W.C.

Woolf, Albert Edward, 832, West End-avenue, New York City, U.S.A.

Wright, Rev. Dr., M.A., 796, Astor-street, Milwaukee, Wis., U.S.A.

The paper read was—

THE FISCAL PROBLEM.

By Sir Charles Malcolm Kennedy, K.C.M.G., C.B.

The Society of Arts was founded for "the encouragement of the arts, manufactures and commerce of the country," and one of its specific duties is to endeavour "to increase the trade of the realm by extending the sphere of British commerce." The consideration of the very important question before the country, which is designated briefly — the "Fiscal Problem"—comes, therefore, properly within the functions of the Society, provided that the subject is treated on grounds of general public interest. The subject it is true cannot be placed before the Society without entering upon topics of political as well as economic controversy; yet the aim here must be, while these topics are clearly set forth, to discuss these matters without reference to political or party exigencies. The position of the Society of Arts should enable us to do so. Difference of opinion is to be expected. If, however, the limitations above indicated are observed, our discussion this evening may be of use to our members.

The scope of this paper is first to trace the adoption of the present fiscal policy and tariff of the United Kingdom, the principal European powers, and the United States. Secondly, to explain (sufficiently for the purposes of the paper) the present commercial, industrial, and economic position of these powers, and to advert to some details connected with these questions. Then, after stating the colonial aspect of the case, we shall be able to enter upon the consideration of the proposals now before the country; and to form an opinion on the circumstances which have led up to these proposals, as well as on the objections which are urged against them. It is hoped that in this manner we may aid the members of this Society in their individual appreciation of questions which are of the highest importance, both to our national interests and to the international relations of the Empire.

The fiscal question, taken in its full significance, comprises all matters connected with public revenue and disbursements—their principles and details. The problem now immediately before the country, is, however, mainly concerned with the Customs systems of the United Kingdom, and of the British colonies and dependencies. This paper is written mainly on the latter standpoint; and the general question will only be adverted to by such incidental references as may be found necessary for our special purposes.

Customs Tariffs 1840-1860.

One of the most influential agencies in the extension of international commerce during the latter half of the 19th century was the reform of Customs tariffs. The re-settlement of the political system of Europe in 1814-15 did not effect any direct changes in the commercial relations between the different Powers; but it indirectly prepared the way for improvement in Central Europe by means of the regulations adopted at Vienna in March, 1815, for the free navigation of rivers. The Zollverein, as constituted in 1834, and the gradual accession of German States to this Customs Union, made customs reform known practically on the continent, but without early results. It strengthened, however, the example afforded within the United States of the benefits of unrestricted intercourse, and of a centralised Customs administration.

The first reform on a comprehensive scale took place in the United Kingdom. It began with enactments introduced by Mr. Canning and Mr. Huskisson; but after these early improvements a committee of the House of Commons on Import Duties reported in 1840 that the tariff possessed "neither congruity nor unity of purpose: no general principles seem to have been applied. The tariff often aims at incompatible ends: the duties are sometimes meant to be both productive of revenue and for protective objects, which are frequently inconsistent with each other. Hence they sometimes operate to the complete exclusion of foreign produce, and in so far no revenue can of course be received; and sometime when the duty is inordinately high, the amount of revenue becomes in consequence trifling. An attempt is made to protect a great variety of particular interests at the expense of the revenue, and of the commercial intercourse with other countries." The above remarks are supported by a tabular statement showing the duties received in the financial year 1838-39 under the Customs tariff of 1833 which was then in force:—

			£
349	articles yielded	on an average less than	24
132	,,	,,	240
45	,,	,,	713
107	,,	,,	2,290
63	,,	,,	22,180
10	,,	,,	183,864
9	,,	,,	2,063,865

147 articles yielded no revenue.

The total number of headings or items in the tariff was thus in 1840—862.

The principles of Sir Robert Peel's fiscal legislation were to clear the tariff from charges which did not defray the cost and trouble of collection; to cheapen raw materials for use in manufacture; to assist manufacturers by the reduction of certain duties and the repeal of others; and to replace a sliding scale of duties on corn by a fixed charge of one shilling per quarter. As regards colonial produce, the tariff in force in 1840 contained 82 different headings, under which preferential duties were allowed in favour of British colonial products. The repeal of duties lessened this number; but the principle of preferential treatment in favour of British possessions was maintained. Such was the free trade system inaugurated by Sir Robert Peel between 1842 and 1846. The number of distinct headings in the Customs tariff of the United Kingdom was reduced from 862 to 450.

It is necessary now to explain how this reform of the British Customs tariff was brought about. Before 1830, the political and social system of the country was based upon the predominant influence of the landed interest. The Reform Act of 1832 was the outcome of events which had occurred in the preceding half century. During this period, population had largely increased; new interests had become established, and fresh opinions had entered men's minds. In the Parliaments successively elected under the Act of 1832, the industrial element in the House of Commons obtained a constantly increasing influence. Up to about 1765, England was a grain exporting country. In the preceding 50 years there were only five deficient harvests. After 1765, unfavourable seasons became frequent, and the country needed food supplies from abroad to provide for home requirements. The policy of the Corn Laws of the 18th century, was to check the importation of corn; and by favouring the cultivation of arable land to provide employment and remuneration for the agricultural population; and to uphold rents. At the close of this era of corn-law legislation, wheat was admitted from abroad on payment of duties varying in amount according to market prices, preferential rates being levied on British colonial corn. In 1841, however, as before observed, great changes had taken place. The census returns showed a population in Great Britain of 9,000,000 in 1801, and of 18,500,000 in 1841. This large increase, chiefly in towns, and the great development of trade and manufactures, rendered a relaxation of restrictions on the importation of food stuffs and raw materials absolutely necessary. A great popular movement arose in favour of the policy designated Free Trade, and in 1838 the Anti-Corn Law League gave stronger effect to previous action for tariff reform. Its objects, in the words first used, were the abolition of the duty on the importation of foreign corn, and the adoption of free trade as "the only security for manufacturing, and the welfare of every portion of the community." It will thus be readily understood that in 1841 and the next ensuing years the whole fiscal system of this country was no longer in harmony with the ideas and requirements of the times. The relative position of the agricultural, commercial, industrial, social, and political interests of the country, and the wants of each class, had much changed. Bad harvests, contraction of the currency, financial crises, and trade depression, created dangerous conditions of public affairs; and it was well for the whole empire, and for us who have lived in subsequent years, that British statesmanship between 1842 and 1846 carried into effect changes then necessary for the public safety, although in some details beyond what was really needed, before the revolutionary storm of 1848 burst over Europe.

The advocates of the Free Trade movement in England had large expectations as to the influence which it would exert abroad. Mr. Cobden said on the 15th of January, 1846, "I believe that if you abolish the Corn Laws honestly, and adopt Free Trade in its simplicity, there will not be a tariff in Europe that will not be changed in less than five years to follow your example." In a letter to Mr. Ashworth, written in 1842, Mr. Cobden expressed his anticipation that Free Trade "will gradually and imperceptibly loosen the bonds that unite our colonies to us by a mistaken notion of self interest"; and will also be the "only human means of effecting universal permanent peace." On the 27th of January, 1846, Sir Robert Peel, while admitting that since the beginning of his tariff reforms, foreign countries "have not only not followed our example, but have applied to the importation of British goods higher rates of duty than formerly," added: "But your exports, whatever be the tariffs of other countries, or however apparent the ingratitude with which they have treated you—your export trade has been constantly increasing. By the remission of your

duties upon the raw material, by inciting your skill and industry, by competition with foreign goods, you have defied your competitors in foreign markets, and you have been able to exclude them. Notwithstanding their hostile tariffs, the declared value of British exports has increased above ten millions during the period which has elapsed since the relaxation of the duties on your part. I say, therefore, to you that these hostile tariffs, so far from being an objection to continuing your policy are an argument in its favour. But depend upon it your example will ultimately prevail. When your example could be quoted in favour of restriction it was quoted largely; when your example can be quoted in favour of relaxation, as conducive to your interests, it may perhaps excite at first in foreign Governments or Boards of Trade but little interest or feeling; but the sense of the people—of the great body of consumers—will prevail, and in spite of the desire of Governments and Boards of Trade to raise revenue by restrictive duties, reason and common sense will induce relaxation of high duties. That is my firm belief; I see symptoms of it already." In his last speech on economic questions in July, 1849, Sir Robert Peel maintained his previous opinions and said, "I maintain that the best way to compete with hostile tariffs is to encourage free imports."

The anticipations entertained by the promoters of the Free Trade movement in England were—(1) That this policy would be followed at home by an extension of trade and prosperity; and that the example thus set by Great Britain would be soon followed by other States. The latter anticipation was not fulfilled. Fruitless negotiations took place between 1842 and 1845; but the relaxation of foreign Customs tariffs was deferred until 1860, and was occasioned by other circumstances. The beneficial effects at home, contemporaneous with the tariff reform of 1842-46 were, in a large measure, also owing to other circumstances. The admission of sea-borne corn at low rates of duty between 1846 and 1849, when the duty became uniform at one shilling per quarter, took away the sense of public grievance. But it did not effect at once a permanent lowering of the price of bread, which continued to fluctuate, and in 1854 wheat attained the high figure of 74s. 8d. per imperial quarter. Mr. Gladstone recognised this fact. Speaking of the results of free trade legislation in connection with the working classes, he said.—

"Take the great change in the Corn Laws; it may even possibly be doubted whether up to this time you have given them cheaper bread, at best it has been but a trifle cheaper than before; that change, however, is one material indeed, yet, it may almost be said, comparatively immaterial; but you have created a regular and steady trade in corn, which may be stated at £15,000,000 a year; by that trade you have created a corresponding demand for the commodities of which they are the producers, their labour being an essential and principal element in their production, and it is the enhanced price their labour thus brings, even more than the cheapened price of commodities, that forms the main benefit they receive." (Financial Statements, 1853-63, p. 129, Budget Speech, February 10th, 1860.)

The price of wheat did not fall permanently below 40s. per quarter until 1884; and it was occasioned by the extension of wheat cultivation under means of communication unforeseen in 1846. The uncertainty of the incidence of duty under a sliding scale, when the carrying capacity of vessels was limited and communication was slow, was the main cause of dearness of food. There is, however, reason to think that while Free Trade has been beneficial in past years to England and Scotland, its effects have not been equally satisfactory in Ireland. Agricultural distress had much to do with agrarian troubles.

Mr. Newmarch, in his paper read in June, 1878, before the Royal Statistical Society, shows how industry was impeded before the gold discoveries of 1848-51. He said: "Prior to 1849 the annual supplies of gold available for all the purposes of coinage, bullion reserves and commerce, had been about £4,000,000, an amount barely sufficient to meet the wear and tear of the gold coins in circulation. In 1850 the supply was raised to £9,000,000, in 1852 to £27,000,000, and in 1856 to £32,000,000, a revolution far surpassing any economic change within record." These gold supplies created what is now termed a "boom;" confidence in commercial transactions revived, railways opened out new channels of communication, and trade was largely extended. While it is shown that the expectations of the leaders of the Free Trade movement were partly not realised, and partly brought about by events which they could not foresee, it is to be remembered that the period of the forties was an era of social amelioration, and of enthusiastic anticipations. Notwithstanding much distress and discontent, it was a period of expectancy, and possessed the great charm

of the years when these popular feelings prevail. "Coningsby" and "Sybil" aided in uniting together the two nations of the rich and the poor; and many of the advantages enjoyed in these latter years had their origin in efforts made without much notice, in the decade of the forties, in furtherance of social improvements.

In now placing before this meeting certain statistics, it is right to call attention to some cautions connected with them. Scarcely any one year can truly be designated a "normal" year in commercial transactions, undisturbed by exceptional conditions in some quarter or other of the world. International commerce is now so complicated and interwoven, and credit is so sensitive, that events in distant regions effect markets in far off countries. For scientific statistical purposes, an average of years should be taken, and these averages often need to be checked, and allowance made for disturbing causes. The statistics now placed before you are to be regarded as illustrations and indications rather than as exact correlations to each other. The increase in British trade after Sir Robert Peel's tariff reforms, may be thus shown. In 1842 the official values, in round figures, were—Imports, £65,250,000; exports, £100,000,000. In 1853, £123,000,000 and £214,000,000. Customs receipts were—in 1839, £22,100,000; in 1842, £22,700,000; and in 1853, £22,500,000. Although after 1841, Custom duties were reduced to the estimated amount of £10,000,000, yet the loss to the revenue was only about £200,000 as compared with 1842. The Excise receipts (part of which were closely associated with Customs duties) in 1842, £14,600,000; in 1853, £16,300,000.

THE COMMERCIAL TREATY SYSTEM, 1860-82.

The tariff reform in Europe which Sir Robert Peel and Mr. Cobden had expected in 1846, did not come to pass. In ths words of Sir Louis Mallet, one of Mr. Cobden's most eminent followers, "during the fourteen years which succeeded the repeal of the Corn Laws, notwithstanding all the tariff reforms which preceded and followed that measure, no reduction of any importance was made in the tariffs of Europe; and, great as was the impulse given to our foreign trade by the independent remission of duties upon our imports, the restrictions still maintained in foreign countries was beginning to be seriously felt. In 1847, the year after the repeal, the value of British exports to the countries which entered into the treaty system of 1860 was £18,394,000. In 1856 it had advanced to £35,936,000, but in 1859, the year before the treaty with France, it had fallen to £32,489,000. In 1868, after the conclusion of the French treaty and the 50 or 60 similar European treaties to which it gave rise, the British export trade to the same countries had advanced again to £60,739,000, while the total addition to our trade with them in imports and exports was no less than £84,000,000."

The main characteristics of continental tariffs before 1860 were prohibitions to import, high duties more or less equivalent to prohibitions, and Customs regulations restrictive to foreign trade. In the French tariff, which was the worst in these respects, the importation of cotton manufactures, iron in bars and prisms, brass wire, lead shot, prepared skins, refined sugar, and tobacco (except for Government factories) was altogether prohibited; certain goods were only admitted when imported in French vessels. There was on the continent no generally recognised system of Customs imposts; and in commercial treaties the wording of the most favoured nation article was usually limited and defective. In 1860, a Government existed in France, sufficiently enlightened and powerful to revert to the policy which had established by the commercial treaty of 1786, but which was brought to an end by the French Revolution. The basis of the treaty of 1860, and its supplementary conventions, were—(1) on the part of Great Britain, the abandonment of the remaining protective duties in the British Customs tariff, and of most preferential rates in favour of British colonial produce, and the reduction of the duties which were maintained to rates fixed to serve fiscal purposes only; (2) on the part of France a general transition from prohibition or high duties to a moderate Customs tariff.

The fiscal system which then prevailed in Europe, enabled France to withhold from other countries the benefits of the new tariff, unless and until each of these countries modified their tariffs in a corresponding manner. All European States in effect were thus obliged, in order to maintain their trade with France, to conclude new treaties which were drawn up in conformity with the Anglo-French Treaty. In the words of Sir Louis Mallet, a new era was begun in the free trade policy, "its leading principles were—the international regulation of international trade, and the simultaneous removal of international restrictions, not for the pur-

pose of exclusive privileges and tariff bargains, but with a view to the equalisation and generalisation of tariffs." The first of these new arrangements having been negotiated between Great Britain and France, the classification of goods was naturally settled to suit the trade between the two countries. Every business man knows that the classification of goods adopted for the assessment of customs duties is as important as rates of duty. France having adopted a fresh customs classification by the conventions supplementary to the treaty of 1860, adhered to it in the arrangements subsequently concluded with other Powers; and thus the new European tariffs became specially serviceable to the trade of the United Kingdom; and the benefit of their provisions was secured for our trade by means of a better worded most favoured nation article in new commercial treaties. By the commercial treaty of December 16th, 1865, with Austria, the British Government engaged to abolish the import duty on wood and timber, and to equalise the duty on wine in bottle and in cask. The principle of preferential treatment for colonial products which had hitherto been maintained in our Customs tariff came to an end, under these arrangements with Austria in 1866. The number of separate headings in the British tariff which, as before stated, were reduced to 450 after 1846, were under the commercial treaty system of 1860 reduced to 92 items in the financial year 1860-61, and to 70 in 1867-68. Mr. Gladstone, in his article on Free Trade, Railways and Commerces in the *Nineteenth Century*, February, 1880, summed up the effect of the Customs Act of 1860, which gave legislative sanction to the provisions of the French Treaty, as follows:—

"1. That neither on raw produce, nor on food, nor on manufactured goods should any duty of a protective character be charged.

2. That the sums necessary to be levied for the purposes of revenue in the shape of Customs duty should be raised upon the smallest possible number of articles."

The remission of the duties on paper, sugar, and timber in following years were made in conformity with these principles.

The action of Mr. Cobden and his followers in these matters was founded on business as well as on economic grounds. The well-being of workpeople, and especially of women and children employed in factories did not find especial support either from them or Sir Robert Peel. They objected to legislation either for limiting hours of labour, or for the protection of workers from personal injury. They wanted the free import of raw materials to be worked up in this country; and to attain this end they coalesced with the opponents of the Corn Laws. They wanted also to obtain access to European markets as being valuable (1) on account of near neighbourhood; (2) as possessing purchasing power; (3) greater security for trade purposes than distant regions; and (4) as affording quick returns, approximating to the profits of a home trade. They were not apprehensive of foreign competition either at home or abroad; and laid stress on the effect of British example in fiscal questions.

This policy was successful during several years. Comparing the total movement of trade between the United Kingdom and the principal European countries, which came into what is designated the conventional tariff system, the growth of the total movement of British trade in the years before the principal European countries came under this influence, contrasted with the figures for 1873, when the first effects of the Franco-German war had passed off, and commercial relations had resumed fair normal conditions, and with the figures for 1902, inserted here for convenience of comparison, the growth of the whole trade stands thus:—

	Million £.
France.	
1859	26,431
1873	73,535
1902	72,918
Belgium.	
1861	18,731
1873	27,305
1902	39,158
Italy.	
1862	8,785
1873	12,402
1902	11,675
Germany.	
1865	44,764
1873	56,635
1902	66,728
Austria-Hungary.	
1865	1,538
1873	2,684
1903	3,851
Holland.	
1865	27,373
1873	37,850
1902	47,913

Russia.	
1865	23,563
1873	32,734
1902	39,666
Sweden and Norway.	
1865	5,829
1873	12,343
1902	23,354
Spain.	
1865	7,784
1873	15,500
1902	19,651
Portugal.	
1865	5,021
1873	7,667
1902	5,669

On these figures I would remark again that they are only to be taken as illustrations, given in an easy shape. It may be useful to conclude this part of the subject by taking the figures of British export trade in groups of years as given by Mr. Gladstone in the article of 1880 above referred to; his explanation of the reasons for this arrangement are (if I may venture to express an opinion) sound and sufficient; they can, however, only be stated here without explanations; and they express the case strongly from the free trade and early fiscal reformers' point of view:—

	Million £, average.
1816-18	42
1819-22	35
1822-24	36
1825-27	36
1828-30	37
1831-33	38
1834-36	47
1837-39	48
1840-42	50
1843-45	57
1846-48	56½
1849-53	72
1853-55	94
1856-59	124
1860-66	149½
1867-70	187
1871-78	220

These figures prove the growth of the trade of the United Kingdom after 1842, and especially after 1860. It must, however, be duly remembered that tariff changes do not create trade. A tariff may remove, as it may impose, restrictions upon trade. After 1842 these barriers were gradually removed here; and after 1860 they were lessened on the Continent. But these results were very largely made possible by improvements in communication. Extension of railways, development of steam navigation, the use of the telegraph, and the influence of the gold discoveries, effected great changes in commercial operations, and led to the opening up of vast regions beyond the seas. Mr. Gladstone, in the article above referred to, maintained that a sound political economy had done more than inventive genius for the enlargement of commerce and wealth. Without the latter, however, relaxation of Customs tariffs and regulations could not have afforded adequate means for the extension of international commerce during the last half-century.

The Treaty System, 1882-1903.

In England Free Trade was adopted as being the outcome of popular convictions in a social crisis, in order to alleviate or remove existing difficulties. On the Continent no such popular movement had arisen. Tariff changes were brought about in continental countries by the Government; to use a common expression, they were imposed from above. In England the protectionist opposition continued strong for several years after 1846, and it still exerts a political influence. On the Continent the new commercial policy was much resented in many quaters. The general gain which a liberal commercial policy confers is counterbalanced, for a time at least, by the loss occasioned to various localities, special interests, and individual businesses. Circumstances favourable to the changes effected, and the healing efficacy of the lapse of time, are necessary before this irritation and sense of loss can pass away. In England, after 1846, in the next generation, Free Trade principles were generally adopted. If peace had been preserved in Europe for fifty years after 1860 free trade principles would probably have become firmly established and much further extended in operation. In 1864, Mr. Cobden was disquieted at the slow progress made in France by the free trade movement, and he was apprehensive whether the commercial treaty policy would be upheld at the date when the treaty of 1860 would be terminable. The Imperial Government in France, notwithstanding the hostile attitude of the Liberal political opposition, and of the manufacturers, persevered in their truly liberal commercial policy, and in consequence of treaties concluded during the latter years of the Empire the duration of the commercial treaty system became prolonged from 1870 when the Anglo-French treaty was terminable,

until 1877. In Austria the treaty of December 16th, 1865, with Great Britain, had been strongly opposed. Thus in Austria, and also in Germany, feelings and conditions similar to those existing in France, prevailed. The treaty system of 1860 was accordingly by no means secure; its permanence depended upon the course of events; and the course of events became unfavourable. The Franco-German war disturbed political and commercial relations. The enormous indemnity of £220,000,000, exacted by Germany, destroyed the equilibrium of the French finances, and changes in the fiscal arrangements of the country became absolutely necessary. The monetary and commercial results of this war affected all the Continent. The demonetisation of silver in 1873 prevented recovery from these disturbing causes, which became accentuated with the great fall in the value of silver in and after 1876; and by commercial failures between 1875 and 1878. There was likewise a decline in prices in this period. Contemporaneously there were changes of economic conditions, and of processes of manufacture in many localities on the Continent. The cost of military and naval armaments permanently augmented. Accordingly the Governments sought new taxes to defray these expenses; and, therefore, were disposed to adopt the views of those interests which demanded an increase of the rates of Customs duties. The French Government gave notice to terminate the two earliest commercial treaties—those with Great Britain and Belgium—with the view to effect some alteration in their fiscal policy with respect to import duties before 1877, when they could be entirely free in these matters. The aim, on the other hand, of the British and Belgian Governments was to avert differential treatment adverse to their commerce. In the end, by goodwill on each side, the French conventional tariff remained in force. By the treaty of July 23, 1873, between Great Britain and France, the duration of the arrangements of 1860 was prolonged until June 30, 1877, definitely, and until after notice for termination was given; and improvements were introduced into the shipping and other provisions of the treaty of 1860. Negotiations of an inconclusive character took place between different Powers. Austria first broke away from the treaty tariff system of 1860, and terminated her principal treaty engagements towards this country and France at the end of 1876 and 1878. This breach in the tariff system inaugurated by Mr. Cobden's negotiations, gave an impetus to the action in France in favour of higher duties. The Lancashire and Yorkshire manufacturers, more especially, in the course of the British negotiations, did not realise the exact position of affairs. They pressed demands for tariff reductions in France, instead of endeavouring to secure the maintenance of Mr. Cobden's rates of duty, with the smallest additions thereto, which the French Government would accept. In the circumstance these demands were not reasonable; the French Government could not concede them in the existing conditions of the national finances and sentiments. The tariff arrangements which France had contracted with Great Britain came to an end in February, 1882. Belgium and other European countries made fresh tariff treatises with France, less liberal in their terms as regards foreign manufactures than those of 1860, but much better than the Customs system previous to 1860. In these new treaties, the classification of goods and the rates of duties were adopted without regard to the requirements of British trade. In this period, the Customs administration of several countries favoured the policy of a Customs tariff on a system of double columns of duties; the one of high rates for general application in the absence of sufficient reason to the contrary; the other of low rates—a percentage beneath the scale in the first column—to be applied to the goods of countries to whom most favoured nation treatment is accorded. The policy in favour, is to settle the first column entirely by domestic legislation; and the second also, as far as possible. In the second column, in the course of commercial negotiations with other Powers, modifications are made, but to the smallest extent, which the other party to the treaty will accept. In 1892, France ceased to take the lead in international tariff arrangements. Germany then took this system in hand between 1891 and 1894, and concluded commercial treaties of twelve years duration with Austria-Hungary, Belgium, Italy, the Netherlands, Russia, and Switzerland. These treaties are framed to favour and develop German trade, which has prospered under their arrangement, as that of the United Kingdom progressed under the treaty system of 1860. The foregoing statement on this part of the subject is sufficient for the earlier portion of this paper; but some further remarks will be necessary in considering the industrial conditions and policy of different countries at the present time.

It should be mentioned that Russia did not

enter directly into the western European commercial system in 1860; but confident expectations were entertained that a liberal fiscal system might be introduced there. The complications which ensued after 1870 caused disappointment here also. In January, 1877, Customs duties were ordered to be levied in gold, which in effect raised their amount by about 15 per cent. The cost of the war with Turkey in 1887-8, and expenses for internal development, required additional income; and the tariff was increased generally in 1881-82, in 1884-85, and again in 1887 and 1900. These augmentations, and those of the German tariff in 1879, 1885 and 1887, led to recrimination between the two States; and to the tariff war of 1893-4, which will be explained further on. The present Russian tariff is drawn up on the double column basis; it came into force in January last, and is of a highly protectionist character, and it is likely therefore to influence German fiscal policy in this direction.

Turning now to the United States, before the civil war of 1861 the Customs administration of the United States was liberal in its application; its bearing towards foreigners was lenient, and it exerted a decided influence in the action taken in these matters in this country. The civil war necessarily disturbed previous financial arrangements. A larger public revenue was needed. In these altered circumstances the workpeople and manufacturers united in demanding, in the increase of taxation between 1861 and 1865, that the Customs tariff should be so regulated that the workmen and manufacturers might secure the home market for their labour and their goods; and the country should provide for its industrial wants. A protectionist policy was accordingly enunciated, and adopted by Congress with very general approval. In December, 1887, President Cleveland sought to check the profuse expenditure which had grown up under the large revenue of recent years, and to reduce it to the wants of an economical peace establishment. He was defeated at the presidential election of 1888, and the existing protectionist policy was made more stringent. The McKinley tariff came into force in October, 1890; it increased duties and granted bounties; and the simultaneous Administrative Act made the Customs regulation more onerous to passengers, as well as to trade. The McKinley legislation further established the principle of reciprocity in tariff arrangements with foreign countries, by restricting the wider interpretation of the most favoured nation clause, and limiting reductions of Customs duties to countries that granted to the United States, under special reciprocity agreements, concessions held to be equivalent to minimum duties allowed by Congress. The continued wasteful public expenditure, and the high tariff, occasioned a reaction in public opinion; and by the Wilson Act of August 28, 1894, raw materials were, to some extent, made free, and other slight alterations were adopted. But the protectionist fiscal policy regained public support; and by the Dingley Act of July 24, 1897, duties were again raised. This Act is the present Customs law of the Republic; its leading provisions are stringent protection in favour of native labour, and the monopoly of the home market for American goods. The conveyance of merchandise between ports of the territories of the Union—between New York and Honolulu for example—is declared to be coasting trade, and is restricted to the national flag; and by means of reciprocity arrangements it is sought to bring neighbouring countries under the commercial and political sphere of influence of the United States.

The principle underlying the changes of fiscal policy in European continental countries since the lapse of the commercial treaty system of 1860, and also in the United States, is that home industries should be developed by legislative action in order that the home markets should be supplied, as far as possible, by home products. The aim of this policy is to make each country, generally, self-supplied, and not dependent on foreign supplies. In Europe the policy of regulating trade by treaty is still, to a large extent, maintained. In France and Germany it is further sought to raise, as far as possible, food supplies within the country. In all these States the Government and Legislature favour by various means the additional aim of securing outlets abroad, both in regular trade and for the disposal of surplus products. In British colonies, as a general rule, popular opinion favours a policy of encouragement to home industries by duties on imported goods, and in certain instances by bounties on production.

Protectionist Policy in Foreign Countries.

We have now to endeavour to appreciate the facts which underlie the preceding statements. Free trade favours the importation of goods from abroad, accompanied, however, by

injury to many interests, localities, and businesses. Under present circumstances in the world Customs duties form an important part of the fiscal revenue of the State indispensable for public purposes. In newly organised countries any large system of direct taxation is practically impossible. In older and more settled countries the requirements of the public services are at the preset time so heavy, with small prospect of any diminution of these charges, that Customs duties are there also a financial necessity. The object of existing protectlonist policy is to secure for native industry the supply of the home market, to establish and develop foreign trade, and to get rid of surplus stocks without delay by selling off cheaply in foreign markets, whenever the absence of a Customs duty allows this operation to be effected.

On the general question Sir Robert Giffen well expressed the case in his paper on the use of import and export statistics in June, 1882. He said the question whether free trade or protection favours most the prosperity of a people cannot "be treated practically from a material point of view alone: political and moral considerations must come in." "I could quite understand a free trader admitting a protectionist system to be the best materially; and a protectionist admitting the free trade system to be the best materially; and yet each on moral and political grounds preferring the less advantageous system in a material view. But how difficult to trace out all the effects of an economic régime in the moral and political sphere. Even materially there can hardly be adequate statistics." It is easy to allege or to prove theoretically that a protectionist policy does harm from certain points of view. It is a different thing to examine the whole subject practically, to estimate exactly the "harm" so accruing in its actual circumstances, and to reckon whether, and to what extent, this "harm is counterbalanced in other directions." Mr. Gladstone (Morley's "Life of Gladstone," ii., 68) recognised that budgets alone (that is the policy to which they give effect) do not make prosperity. Customs tariffs are only one of the factors which have to be taken into account in connection with industrial enterprise, and only express the fiscal and economic policy for the time being of the State by which each tariff is adopted. The broad fact is that during the 19th century, happiness, knowledge, and public welfare have largely advanced in the world; it has been a century of progress in all civilised lands; and of great diminuticn of areas of misgovernment. There has been a wide distribution, as well as a vast accumulation of wealth, under dissimilar economic and fiscal systems. Free trade, it is maintained, augments the total wealth of a country. On the other hand, it is contended, that in a manufacturing free trade country workpeople are subject to permanent or temporary loss of employment from the influx of goods from abroad at seasons and in quantities which cannot be foreseen. Workpeople cannot readily change their occupation; a silk weaver cannot become a coal miner, nor an agricultural labourer an engineer. Practically, change of occupation is difficult. Under present industrial conditions, a fiscal policy which will ensure necessary contributions to the public revenue, and subsistence for the people, would seem to afford advantages to the whole community (and especially to the agricultural, industrial, and shipping interests), which would counterbalance any injury or loss that might be occasioned by a judicious and moderate Customs tariff.

Recent diplomatic and consular reports show that in Germany a protectionist policy is likely to be continued, and that it may even be more accentuated. There seems also to be some chance of the formation of a Central European Customs Union; and that the Netherlands may revert to preferential trade arrangements between Holland and the Dutch Colonies. There does not appear to be any prospect of a change in the fiscal policy of other European Powers, nor in American or Colonial protectionist countries. It is true that the Democratic party in the United States include financial reform in their programme, but many events must happen before any reduction of Customs duties could be made in the United States; and the Wilson tariff of 1894 does not encourage sanguine expectations in this direction. There are also free trade parties in the other countries referred to, but their political influence is in all instances weak, at least for the immediate future. The necessity to rely upon indirect taxation is not confined to new countries. The Swiss Federal Government cannot impose direct taxes, and is compelled therefore to raise its revenue from indirect taxation, of which Customs duties form the principal part. The German imperial administration is largely dependent upon indirect taxatien, and especially customs duties. And in most continental countries the demands on the exchequer for military services now leads to an irresistible

tendency to augment indirect taxation. There does not appear to be any prospect as yet of large reductions of public expenditure by any power. Military and naval requirements are not likely to lessen.

Tariff Wars.

Before concluding this part of the paper, international disagreements which have led to definite retaliatory action should be mentioned. Passing over measures relating to public health, adopted in consequence of insufficient sanitary precautions in particular foreign countries, and which are usually effective in bringing about satisfactory arrangements on these points, a recent Colonial instance may first be adduced. In 1885, the Canadian Legislature passed a law affecting certain Newfoundland products. The object in view was to bring pressure upon Newfoundland, either to become part of the Dominion, or to grant certain terms desired on behalf of Canadian trade. Thereupon the Newfoundland Legislature imposed additional duties on imports from any country which, while making use of Newfoundland fisheries, imposed a discriminating duty on the produce of those fisheries caught by Newfoundlanders, and imported into such countries. In consequence of this threatened retaliation, the Canadian Government did not enforce the Act under which the duties in question were to have been levied.

France and Italy.—The operation of the Commercial Treaty of 1882 did not afford satisfaction to either country; and notice was given for the termination of its tariffs in 1888. Italy adopted a protectionist tariff in July, 1887. Long and fruitless negotiations ensued; and on March 1st, 1888, special retaliating tariffs came into force in each country. These restrictive measures were taken off by mutual consent in January, 1890, when their products came under the ordinary tariffs. In November, 1898, a commercial agreement was concluded between the two Powers on the basis of most favoured nation treatment with special tariff arrangements with regard to certain goods. The results were that Italy lost great part of her wine trade with France, and France ceased to supply Italy with colonial products; and certain branches of Italian textiles, iron, and machinery trade passed to German houses.

Germany and Russia.—The commercial relations between these two Powers were disturbed by their respective alterations of tariff between 1885 and 1893. The Russian Government established a new maximum tariff in 1893, and applied it to German goods. Germany replied by similar measures. Very influential interests in the two conterminous States were affected, and it became necessary for both parties to replace their trade relations on a friendly footing. A new treaty was negotiated and came into force in March, 1894. Each Government seems to have been satisfied that their respective grievances were removed.

France and Switzerland.—The French Chamber of Deputies rejected in December, 1892, a Bill to accord to Switzerland certain improvements on the minimum tariff of 1892. In the end France granted a few concessions to Switzerland, and Switzerland simply granted most favour-nation treatment to France. The trade between the two countries appears to be still below the level of the years previous to the protectionist French tariff of 1892, and the Swiss transit trade seems to have been diverted to other channels, and German and Italian houses have gained in the Swiss market to the detriment of their French competitors.

Germany and Spain.—In 1894 the commercial treaty concluded between the German and Spanish Governments (which was in most respects framed upon the same principles as the treaty existing previously between Germany and Spain) was rejected by the Spanish Cortes, and in consequence German goods in Spain (and Spanish goods in Germany) were deprived of any "most-favoured nation," or tariff privileges enjoyed by them, and were subjected to considerably higher rates of duty than goods imported from most other countries.

The German Government thereupon, viz., in 1895, had a law passed by the Imperial Parliament at Berlin, giving it the right to use more severe relaliatory measures than had until then existed towards countries imposing higher duties on German goods than on those of other States. This new law provided that dutiable goods coming from such States as treated German ships and goods more unfavourably than those of other nations, might be subjected to a further "sentaxe," not exceeding one hundred per cent. of the amount of duty imposed on entry by the German Customs tariff (providing no treaty provision existed of a contrary effect); and that goods which were admitted duty free by the tariff, might, in the same conditions, be subjected to a duty not exceeding twenty per cent. of their value.

The power thus given to the German Government was at once made use of against Spanish goods imported into Germany, and for some time the same were subjected to the ordinary duties of the German general tariff. After about five years the Spanish Government (in view more especially of the prejudice caused to the Spanish wine export trade by these high German duties) found itself compelled to come to terms, and to conclude a fresh treaty of commerce with Germany, which came into force in the year 1900.

Germany and Hayti.—In consequence of the refusal of the Haytian Government to grant German imports and German shipping the same privileges as to those of France (German trade being unfavourably affected by the preferential treatment of French products), the German Government in April, 1901, imposed an additional import duty on the prominent Haytian products brought to this country, viz., coffee, cocoa, and logwood, and this *régime* still continues at the present time.

According to leading opinions at Hamburg, the effect of this tariff war, however, between Germany and Hayti has been almost more detrimental to German trade and industry than to the Haytian export trade, for it is declared that the trade in Haytian dyewood has now almost been entirely diverted to France, and that the dyeing extracts are now made there and exported from France subsequently to Germany.

The Haytian coffee trade is likewise stated to have been more largely transferred to France during the past two years than before. This condition of things is considered to have reacted also unfavourably upon the export trade from Hamburg to Hayti, but it should at the same time be noted that the generally unfavourable financial condition of the Haytian Republic has no doubt likewise had a larger share in prejudicially affecting German trade with that country during recent years.

There have also been, during late years, "tariff wars" between France and Spain and Portugal. The details of these conflicts are not sufficiently known to enable statements to be made respecting them. Tariff wars it thus appears lead to dislocation of commercial arrangements, and to the transfer of particular branches of trade from one country to another. They lead, however, in some instances to the removal of grievances which cannot be otherwise remedied, and thereby prevent lasting injury to particular trades, and may bring about better relations than those which subsisted previous to the conflict. This part of the economic question requires very careful handling, and it especially should not be treated for political party purposes.

The Economic Question.

As regards the economic position of the fiscal problem, it is to be borne in mind that the general conditions of different manufacturing countries, and the capacity and requirements of the working population, vary largely. The differences of wants, habits, and tastes are such that a comparative statement of the governing considerations affecting the occupations and welfare of the people cannot be shown fully by statistical tables. Moreover, an adequate examination of these details, and deductions from their study, in order to present a fair statement of the subject from this point of view, would in itself exceed the limits of this paper. It would also more properly come within the scope of another society. The remarks under this heading will therefore be restricted to certain leading facts, chiefly concerned with the industrial interests of the United Kingdom, but with reference also to foreign countries on points directly bearing upon these enquiries. The following summary of persons employed in the principal productive industries in England and Wales is taken from the recent Board of Trade Blue Book on British and Foreign trade and industrial conditions. In first referring to this publication by its title, it is a matter of pleasure, as well as duty, to call special attention to it. As remarked in the preface, this Blue Book is a collection of separate memoranda, statistical tables, and charts; the information which they afford is very complete, and is not to be found in any other single volume. The study of this volume is essential to a correct knowledge of the subjects now before the country, yet its value and accuracy, and the magnitude of the task accomplished in a short space of time, and in pressure of business, can only be adequately appreciated by those who are familar with economic, industrial, and statistical questions. Public thanks are due in this matter to Sir Alfred Bateman, Mr. Llewellyn Smith, and the whole staff, who have bestowed great care and labour in preparing memoranda on intricate subjects involving much research, and in collecting and revising a mass of figures never before put together in a single volume.

Groups of industries.	Year.					
	1851.	1861.	1871.	1881.	1891.	1901.
Agriculture	1,904,687	1,803,049	1,423,854	1,199,827	1,099,572	988,340
Building	398,756	472,222	583,019	686,999	701,284	945,875
Coal-mining	193,111	270,604	315,398	383,570	519,144	648,944
Cotton	414,998	492,196	508,715	551,746	605,755	582,119
Lace	61,726	54,617	49,370	44,144	34,948	36,439
Woollen and worsted	255,750	230,029	246,645	240,006	258,356	236,106
Linen	27,421	22,718	18,680	12,871	8,531	4,956
Silk	130,723	116,320	82,963	64,835	52,027	39,035
Iron and steel*	95,350	129,507	191,291	200,677	202,406	216,022
Machine-making and shipbuilding†	80,528	123,812	172,948	217,096	292,239	‡
Tailoring	139,219	142,955	149,864	160,648	208,720	259,292
Boot and shoe	243,935	255,791	224,559	224,059	248,789	251,143
Printing and bookbinding	32,995	46,576	64,226	88,108	121,913	149,793
Furniture	47,958	64,148	75,202	84,131	101,345	121,531
Earthenware and glass	46,524	53,611	65,478	68,226	82,760	92,556

* Including ironfounders. † Excluding blacksmiths and ironfounders.

‡ In 1901 a different classification was adopted from that of previous censuses, which makes it impossible to state a comparative figure.

Other official publications relative to the occupations of the people shows the following approximate percentages on the latest figures available to the total population :—Agriculture, 3·47; cotton and woollen factories, 1·90; coal mining, 2·00; iron and steel manufactures, 0·26; shipbuilding, 0·27; total, 7·90; estimating the number of persons employed in minor industries (including fisheries) at 4·10—the relative proportion of the whole classes engaged in productive labour (not including dependents on them) may be reckoned approximated at 12 per cent. of the population of the United Kingdom. The number employed in industries not entirely productive, such as building, and in distributive occupations, may be estimated at 12 per cent. This calculation brings us to the estimate given to me by an eminent statistical authority, that the total industrial population of the country may be reckoned at 10,000,000.

I have not been able to obtain corresponding particulars relative to the employment of the people in other countries. It may be mentioned, however, that according to German statistics for 1895 the percentage of the following occupations to the total population of the empire was :—

Agriculture, cattle rearing, and gardening	15·75
Mining of all kinds	1·09
Coal mining only	·67
Metal work of all kinds	1·67
Iron and steel industry only	·44
Textile industry	1·80

If the amount of exports in years since 1895 may be taken to indicate increase or decrease in occupations, these percentages have increased since that year. The percentage of the average number of persons in the receipt of relief in England and Wales to the whole population, decreased gradually from 4·7 in each of the quinquennial periods, 1855-59 and 1860-64 to 2·6 in 1895-9. The averages of the three years, 1900-2, is below that of the five years, 1895-9; but it is now rising. The statistics of emigration from the United Kingdom are really records of persons proceeding to places out of Europe. They do not aid in the study of the economic question; the number is small, less than 1 per cent. of the population.

Turning next to the information afforded in the Board of Trade Blue Book (p. 260) with regard to the general course of wages in the United Kingdom, it appears that between 1900 and 1903 there has been an increase of remuneration in agricultural and engineering occupations; that it has been stationary in building and textile trades; and that a decrease has taken place in coal mining wages. The general course of money wages is rather below the level of 1900; but it is above the average level of the period 1860-1902. With regard to the prices of food, clothing, and lodging, calculated with especial reference to the case of the labouring classes, this Blue Book shows (1) that the average retail price of the principal foods is much below the cost

25 years ago, but above the rates of six years ago; (2) that there is a steady growth in expenditure on clothing, but it is not proved that this growth is owing to increase in the selling price of these goods; (3) that rents in London have certainly increased in recent years; and it seems also certain that house rent has increased in great Britain, especially in urban districts, since 1891.

Lastly, in connection with matters specially relating to the economic condition of the people, there has been an uninterrupted and remarkable increase in the total computed capital of Post-office and Trustee Savings Banks, since the first returns for the latter in 1854, and for the latter in 1862. The amount for 1902 was £197,100,000.

Comparing the conditions above indicated with the corresponding returns for the three countries for which particulars are included in this Blue Book, the United States, France, and Germany, it is shown that the comparative rates of workmen's wages and family incomes stand in the following order: United States, United Kingdom, France, Germany. As regards the cost of living, it must be remembered that the staple articles of food are not identical in these countries. An exact comparison cannot be attempted within our limits. The conclusion arrived at as between the United Kingdom and Germany is, "That in the last ten years the change in the cost of food has been comparatively small, and has not greatly differed in the two countries." If, however, "we take the first and last quinquennial periods [1886-1890 and 1896-1900] for which complete figures for all four countries are available," the fall in the prices of wheat and meat "was greatest in America, followed by the United Kingdom, France, and Germany." As regards clothing and rent, "the American workman spends more on his clothes than the English; the English more than either the French or the German." With respect to housing, "The evidence of the members of the Moseley Commission on the question whether the American workman is better housed than the English, appears on the whole indecisive." "As regards Germany, there is evidence that the condition of housing of the working classes is inferior to that which prevails in this country." In all these matters, however, "differences of wants and tastes are such that the comparative welfare of the working classes in various countries, in the broadest sense of the term, cannot be determined by any statistical method." In any complete comparison between the economic conditions of industrial countries, other elements — amongst them relative hours of labour, production in working hours, and regularity of employment, must be taken into account.

In the United Kingdom in 1851, 37½, out of a total revenue of 48 millions were raised by indirect taxation; in 1901, 62 out of 122. The ratio of indirect to direct taxation has thus declined from 77 to 51 per cent. In 1901, 92 per cent. of imports were duty free, 8 per cent. subject to import duty. Some of the existing direct taxes, such as the death duties, are a consumption of capital, and therefore economically unsound; the burdens upon land, in the present position of agriculture, are unduly heavy. The limits of taxation have thus been unduly contracted. It is more easy to raise the rates of existing duties than to impose fresh taxes; and often wiser to lower than to abolish duties.

In 1850 the proportionate distribution of our total export as between the protected and unprotected markets of the world was 56 to 44; in 1902 the proportion was 42 to 58. Taking manufactured articles separately, the proportions were, in 1850, 57 to 43; in 1902, 38 to 52. Allowing for certain changes affecting these markets at the two periods, "there can be no doubt as to the effect of continental and American tariffs in checking our own export trade, especially in manufactured articles, with the group of protected countries during the last two decades." (Blue Book, No. 1761, p. 16). It will be remembered that "the last two decades" is the period since the lapse of the commercial treaty system of 1860, which has been explained at p. 44.

In finishing this part of the paper it is well to quote a statement as to deposits in savings' banks per head of population in different countries by Mr. John Rolt Schooling, which appeared in the *Pall Mall Gazette*, of the 16th of October last:—Denmark, £15 11s. 6d.; Switzerland, £13 0s. 3d.; Australia, £7 15s. 10d.; Germany, £7 10s. 7d.; Norway, £7 8s. 7d.; Belgium, £5 7s. 0d.; United States, £6 4s. 10d.; Austria-Hungary, £5 8s. 4d.; Sweden, £5 1s. 5d.; United Kingdom, £4 10s. 10d. These figures are only quoted to show that our own savings' banks returns cannot be used as affording conclusive evidence of greater prosperity existing in the United Kingdom than in other countries. Mr. D. A. Thomas, M.A., M.P., in a paper read before the Royal

Statistical Society, on the 19th of May last—written as a free trade statement before the present fiscal controversy began—sums up his observations respecting the occupations of the people :—"The number employed in agriculture has again largely fallen during the past decade, while those engaged in mining other minerals than coal, in the manufacture of iron and steel, and in the textile industries, have either decreased in number, or not increased proportionately to the growth of the people at large ; and that the increase in the total number has been largely absorbed by coal mining, commerce, railway transport, distribution of goods, and building operations."

THE QUESTION OF FOREIGN TRADE.

In entering upon this part of the subject it is necessary at the outset to explain certain difficulties, and to make certain cautions. Accounts are not made out on uniform bases. The mode in which they are compiled has varied from time to time in each country. Details on those points are afforded at pp. 5 and 6 of the Board of Trade Blue Book No. 1761. The political character of certain territories has changed. Alsace, an important producing province, was included in France up to 1870 ; and since then in Germany. The Hans Towns came into the Zollverein system in 1888. Changes in Colonial possessions—extensions and losses, have likewise altered the headings under which trade with certain parts of the world (more particularly in Africa, and the East and West Indies) is to be classed. Again, recently foreign countries and colonies have been divided into "protected," that is to say countries which maintain tariffs for protective purposes, and non-protected. It has been shown, however, in the narrative portion of this paper that the fiscal policy of European countries and the United States has greatly varied at different periods during the last half century; so here again there are no uniform bases available for long periods.

The Board of Trade reckon Austria-Hungary, Belgium, France, Germany, Holland, Italy, Portugal, Russia, Spain, and the United States to be the "principal protected foreign countries." Holland more especially, and Belgium in a minus degree, are noted "protected" countries, "because a large part of the trade recorded in our official returns, as between the United Kingdom and Holland and Belgium, is in reality, trade with Germany, which passes through Rotterdam and Antwerp, so that it would be misleading to place Holland or Belgium in a different list from Germany." The German tariff is, in its effect, highly adverse to the principal British exports.

Canada and Victoria are the only colonies which are designated "protected" for the purposes of the Blue Book, No. 1761, p. 171.

The following Table gives the estimated average *ad valorem* equivalent of the import duties levied on the principal articles of British export from the United Kingdom :—

	Per cent.
Russia	131
United States	73
Austria-Hungary	35
France	34
Italy	27
Germany	25
Canada	16
Belgium	13
New Zealand	9
Australian Commonwealth	6
South African Customs Union (new tariff)	6

"It must be remembered that the protective effect of a tariff is not necessarily proportionate to the average level of the duties, but also depends on many other factors, such as the comparatively advanced or backward state of the home industries protected. A 25 per cent. duty in Germany may give as complete protection to its native industry as a 100 per cent. duty in a more backward country. A high duty may have no protective effect if the article to which it applies happens not to be manufactured in the country in question."

The effect on British trade of these present tariffs in comparison with business in former years stands thus :—

A.—EXPORTS OF ALL ARTICLES OF BRITISH PRODUCE.

Year.	Principal protected countries and colonies.	All other countries and colonies.
	Per cent.	Per cent.
1850	56	44
1860	51	49
1870	53	47
1880	49	51
1890	46	54
1900	45	55
1902	42	58

B.—Exports of Manufactured and Partly Manufactured Articles.

Year.	Principal protected countries and colonies.	All other countries and colonies.
	Per cent.	Per cent.
1850	57	43
1860	50	50
1870	50	50
1880	47	53
1890	44	56
1900	42	58
1902	38	62

Taking the more important exports and comparing values in 1890 and 1902, the figures stand thus:—

Goods.	1890. Thousand £.	1902. Thousand £.
Chemical products	760	543
Coal	19,020	27,581
Cotton yarns	606	297
,, manufactures	714	563
Hardware and cutlery	110	26
Jute piece goods	94	4
Leather ,,	378	311
Linen yarns	148	109
,, manufactures	152	158
Iron and steel manufactures (except tinplates)	455	390
Woollen and worsted yarn	290	204
,, manufactures	2,746	1,509

In sewing-machines and machinery, except steam-engines and in tinplates, there was a large increased export in 1902; smaller increase in paper, and wool flocks, and nails; a diminishing increase in silk manufactures.

Mr. D. A. Thomas in his paper above referred to sums up his conclusions, "Whatever may be the cause there has been a very serious check to the expansion of foreign demand for British produce during the past ten years, and there is ground for something more than a suspicion that our exports other than coal, both in respect of value and quantity, have become at least for the time being stationary, if not retrogressive."

It is at the same time to be noted, although we cannot enter upon these topics, that the action of trade unions, especially in limiting the work to be done by individual workmen, and strikes leading to importations from abroad, have placed British production at a serious disadvantage in comparison with that of foreign countries.

For complete information on details of trade it is necessary that each inquirer should consult the Board of Trade and also foreign publications. It will be sufficient here to cite two Tables showing in the case of five protected countries the proportion of imports and exports of manufactures derived from and sent to the United Kingdom (percentages):—

Imports.

Year.	Germany.	France.	Russia.	Italy.	United States.
1890	47·1	38·8	23·3	40·3	48·4
1891	47·1	36·7	25·8	Not available	47·3
1892	49·4	36·6	28·5	31·7	44·1
1893	49·2	38·1	26·8	33·4	44·6
1894	46·6	38·4	27·0	31·0	39·8
1895	46·5	39·9	22·8	29·5	44·5
1896	48·9	38·9	21·0	31·8	45·6
1897	48·0	36·6	21·2	26·3	42·9
1898	44·9	34·8	21·5	27·6	40·3
1899	45·2	32·3	22·3	23·9	37·8
1900	40·3	29·7	19·9	22·8	42·2
1901	34·4	28·5	Not available	17·6	36·5

Exports.

Year.	Germany.	France.	Russia.	Italy.	United States.
1890	10·9	26·3	2·7	9·9	not available
1891	11·7	26·8	2·6	not available	,,
1892	11·3	30·6	2·4	8·4	24·5
1893	11·3	29·6	2·3	7·2	23·9
1894	12·3	29·1	4·3	7·4	25·4
1895	11·2	30·2	4·0	6·7	30·5
1896	12·2	29·8	3·6	6·8	28·9
1897	13·0	30·3	3·3	7·4	30·5
1898	12·8	28·9	3·0	6·5	27·3
1899	12·2	30·9	3·6	7·1	26·0
1900	11·8	29·5	3·2	7·5	22·4
1901	13·4	30·8	not available	6·6	24·8

These Tables show that in each instance under the influence of the protective tariff now in force in Germany, France, Russia, Italy, and the United States, the imports from the United Kingdom have decreased. In the cases of Germany and France, the exports to this country have increased; in the case of Italy they have decreased; and in the cases of Russia and the United States they are approximately stationary.

Examining next (from the figures in the

Board of Trade Blue Book) the trade of France, Germany, and the United States in quinquennial periods, the results are :—

Years.	Figures in thousand £.					
	France.		Germany.		United States.	
	Imports	Exports	Imports	Exports	Imports	Exports
1880–4	190,937	138,305	154,377	155,400	59,179	52,827
1885–9	165,970	132,273	162,632	153,538	54,803	42,928
1890–4	168,774	136,786	202,314	155,112	73,569	45,483
1895–9	163,734	144,290	236,723	184,416	112,971	96,165
1902	175,760	170,088	281,550	233,890	94,161	124,733

Swiss statistics supplied to me show also increase of trade :—

Years.	Imports, Million £.	Exports, Million £.
1892	36,903	27,521
1896	42,473	29,546
1902	45,140	34,972

The preceding statements relative to the economic and commercial position of different countries, show a general improvement in their conditions ; and that this improvement has taken place under divergent fiscal systems. These remarks may be concluded with a quotation from a Board of Trade Blue Book of 1902 [No. 1199]: published before present controversies arose.

"The increase of population in Germany and the United States, has recently been greater than the increase in the United Kingdom, and those countries have rapidly developed manufacturing and industrial power. As with ourselves, so with those countries, the set of population has been to the towns; necessarily, therefore, there has been a more vigorous search than formerly for an outlet for the power above referred to. We are still ahead of either country in our power of manufacture for export, but beginning from a lower level, each country is travelling upwards more rapidly than we are who occupy a higher eminence. If peace is maintained, both Germany and the United States are certain to increase their rate of upward movement. Their competition with us in neutral markets, and even in our home markets, will probably, unless we ourselves are active, become increasingly serious. Every year will add to their acquired capital and skill, and they will have larger and larger additions to their population to draw upon. It is necessary, therefore, more than ever, that the change of conditions should be recognised, and we can scarcely expect to maintain our past undoubted pre-eminence, at any rate, without strenuous efforts and careful and energetic improvement in method. The problem, how best this can be done, is of vital interest to all classes of the industrial and commercial community alike, though the assistance which the State can give in the matter must necessarily be of a limited character."

Excess of Imports.

The excess of imports into the United Kingdom which, in the decennial period 1893-1902, has amounted to an average of £161,000,000, has to be considered in connection with the industrial position of the country, more especially as it has given rise to apprehension in some quarters. The question is, are we paying for these imports by means of current industry, or out of accumulated capital? The income tax returns show that there is no apparent inroad upon accumulated capital. The statistical abstract published by the Board of Trade shows that imports exceed exports on all European countries except Austria-Hungary, Greece, Italy and Turkey.

Exports also exceed imports in the case of China, Japan, Morocco, Persia, Mexico, and several American republics. In itself the fact need not be unfavourable, provided that the excess of imports can be attributed to legitimate earnings. In considering this part of the subject, it is to be remembered that certain charges, falling on imports and exports alike, have in the one case to be substracted from and in the other to be added to the official values. This point has been well treated by the late Mr. Newmarch and by Sir Robert Giffen, in papers read before the Royal Statistical Society. It is a difficult and intricate question. The papers referred were read by Mr. Newmarch in 1878, and by Sir Robert Giffen in 1882 and 1876, and they may be studied with advantage. Owing to improvements in the official returns, the allowance to be made under this head is not so large as it was formerly, and the amount assigned is, of course, only an approximate sum. I have estimated it at £3,000,000. Proceeding next to another concealed addition to exports, an informant who possesses complete knowledge of the subject, has been good enough to examine the cost of the provisions and stores embarked on board the 50,000 vessels which leave annually the ports of the United Kingdom for ocean voyages; he is of opinion that the value of these goods may properly be reckoned at £10,000,000. Allowance must also be made for similar supplies to vessels

engaged in the home trade, say, £2,000,000 on this account. Then vessels of war also take out of the country armaments, stores and provisions. Part of the equipment which figures in the budget as military expenditure likewise goes out of the country. These items are in effect exports which do not appear in the trade returns. We cannot this evening examine these matters in detail; it would seem that at a moderate estimate the whole sum may be put down at £30,000,000.

In Blue Book No. 1761 it is stated, "The first great item which is omitted in our trade returns, and which has to be added to our exports, is on account of the earnings of our carrying trade," and after analysis of the circumstances an estimate is offered, "a very rough one," which virtually coincides with Sir Robert Giffen's figures, making £89,500,000 the sum to be added to exports under this heading. Our revision of figures stand thus:—

£30,000,000 exports unreckoned.
3,000,000 charges to be added.
89,500,000 earnings of carrying trade.

£122,500,000

leaving $38\frac{1}{2}$ millions to be accounted for. The second great item in the Board of Trade review of the balance of imports and exports is income from foreign investments; the opinion is expressed that under this heading "we are justified in concluding that $52\frac{1}{2}$ millions is a minimum figure." The conclusion to be arrived at therefore on investigation is that our exports really exceed the imports; a result which explains the continued growth of the yield of the income tax. Yet there is an element of instability in such extensive investments abroad; so long as regular income is maintained the use of this wealth is secure, but there is an absence of control over these funds, and this growth of imports cannot be attributed entirely to sound trade—to some extent it is the outcome of unfair competition. In cheapening goods for consumption, gain is properly accomplished by aiding production, not by flooding markets with low-priced commodities by means of combinations and dumping transactions.

Duties and Prices.

In the present controversy, the point whether or not the consumer pays Customs duties is much discussed. The subject of prices, it is scarcely necessary to say, is very complex. Price depends upon certain regular conditions, and upon certain fluctuating causes. The former comprise the cost of production, and the cost of placing an article on the market—tariff charges form part of the cost of placing on the market. The fluctuating causes are demand and supply; speculation in the particular trade; the use made of business methods connected with each trade; and, in countries where the currency is chiefly paper, variations in the rate of exchange. Different opinions are expressed with regard to most economic questions, when considered with the abstract reasoning of the class room, or from experience acquired in the market. Each opinion may be correct from the standpoint taken. As a practical matter the two points of view need to be combined. Conditions of trade, and local circumstances, vary, and processes of manufacture alter, and therefore general propositions cannot be safely pressed far. Customs duties being fixed conditions, Lord Goschen is right (if I may venture to say so) in regarding a duty as being in a certain sense a charge on the consumer. In practice, however, when the rate of duty is low, dealers take the sum out of the profit accruing to them, under the fluctuating causes above indicated; and the duty is not really added in the payment made by the consumer—nor, on the other hand, does the consumer gain the full amount of a reduction of duty. Let us examine some instances bearing directly on this question, and take first the average price of wheat per quarter, and the average duty per quarter, during the years immediately before and after the repeal of the Corn Laws.

Years.	Price.	Duty on Wheat.	
		Foreign.	Colonial.
1842	57/3	8/5	2/3
1843	50/1	14/3	2/6
1844	51/3	17/2	4/7
1845	50/10	17/10	4/2
1846	54/8	12/2	3/8
1847	69/9	duties	suspended
1848	50/6	5/3	1/-
1849	44/3	1/-	1/-
1850	40/3	1/-	1/-

These figures do not work out the theoretical correlation between Customs duties and prices. In a letter published in the *Times* on the 25th of November, Mr. R. B. Marston shows that there is no exact correlation between the prices of wheat and of bread. The fact that

the repeal of the Corn Laws did not lower the price of bread shows that the popular argument of the big and little loaf is simply a popular delusion. The Blue Blook, No. 1761, shows similar discrepancies between theory and fact in connection with wheat prices and duties in France and Germany. The late 1s. duty on wheat in this country did not occasion an increase in the cost of bread; yet when it was taken off, the price rose in some localities. The increase of duty on wine in bottle in 1888 had partial and not general effects.

It appears further from a recent report in the Diplomatic and Consular series that the German dealer, and not the consumer in Germany, has paid the export duty on English coal imported into the Empire. The conclusion accordingly is, that apart from instances when middlemen and retailers have augmented prices on the alleged grounds of passing events, instances, however, which partisans have cited as authentic results, the broad fact remains that prices are regulated by the conditions and causes above indicated. Customs duties from part of the fixed and regular conditions of trade, and may be said to fall upon the consumer; yet, in fact, when the duty is low it becomes absorbed into one or other of the contingent causes which lead to fluctuation in prices, and it does not become chargeable, in any shape which can be specified, to the consumer. Further, it cannot be laid down as a general rule that the consumer will either bear the whole impost when duties are imposed or increased, or will derive the full benefit when they are reduced or remitted.

The Question of Preferential Colonial Duties.

We have now to consider the practice of countries holding colonial possessions as to (1) Customs' duties charged on the products of these portions of their dominions; and (2) as regards the tariffs in force in these colonies. For a long period it was a fundamental maxim of public policy in all European countries that the commercial interests of their colonies and dependencies should be wholly subordinated to those of the mother country, and often (practically) to the personal interests of the persons or class that governed the State. The Powers which first secured transmarine possessions insisted strenuously upon the monopoly of the trade between the mother country and colonies. In the course of time the system had to be modified, but up to a late period in the last century reciprocal preferential treatment prevailed. It has been shown that in the British tariff the principle of the equalisation of Customs duties on colonial and foreign goods was not generally adopted until 1860, and not entirely adopted until 1866. The home government introduced into the treaties of 1862 with Belgium, and of 1865 with the Zollverein, wholly unprecedented provisions, which prevented preferential treatment by British colonies in favour of the United Kingdom. These treaties are happily no longer in force. The general policy of the home government has been to leave the self-governing colonies free to settle their own Customs duties. In the case of India and the Crown colonies adherence to the broad principles of the home policy is required, with latitude of action as to details by the local administration.

With respect to foreign countries, the present practice of different Powers is well summarised in the recent Board of Trade Blue Book (Cd. No. 1761) on British and Foreign trade and industrial conditions. The summary given at p. 133, as regards the present practice of foreign powers relative to Customs on colonial products, and colonial tariffs now in force, is as follows:—

"(*A*)—Germany and Holland accord no preference to Colonial produce.

"France admits the products of her principal Colonies free, or at reduced rates, but imposes the *minimum* tariff (which is that applicable to goods from the United Kingdom) on the produce of Tunis and the minor Colonial possessions, certain articles being, however, exceptionally admitted free, often in limited quantities.

"Portugal admits most articles from Colonies imported in national vessels at a 50 per cent. preference.

"Spain imposes the ordinary tariff, except on certain specified articles which are admitted free.

"Denmark admits produce of Iceland, Faroe Islands, and Greenland, free, but apparently imposes the ordinary tariff on West Indian produce.

"The United States of America admit the produce of Porto Rico and Hawaii free, but impose duties equal to 75 per cent. of their ordinary tariff rates on imports from the Philippines.

"Japan imports Formosa produce free.

"(*B*)—German, Dutch, and Danish Colonies accord no preference to the produce of the mother countries.

"French Colonies submit French produce to various duties (*Octrois de Mer*) on importation, but have in general an additional Customs tariff imposed on foreign goods only. In the principal Colonies this tariff is practically identical with the

metropolitan French tariff. In Tunis there is an independent tariff from which the principal French exports are exempt.

"Portuguese Colonies for the most part accord percentage reductions to Portuguese goods.

"The Spanish possessions (the Canaries and Fernando Po) have very few duties. Spanish goods obtain no preference in the former, but are treated preferentially in the latter.

"United States goods are imported free into Porto Rico and Hawaii, but are treated in the same way as foreign goods in the Philippines. Japanese produce enters Formosa free."

Germany is a colonial power of very recent date. The colonial system of the present German empire has therefore little bearing on the present question. Some German Baltic ports formerly had colonial interests; but German States were not colonial powers in the period known as the European colonial era. Courland once held a West India island. It is sufficient to say in these remarks that the liberal commercial policy of the Netherlands is quite recent. France, the Netherlands, Portugal and Spain maintained a colonial policy fully as restrictive as that of England in fiscal matters.

The preceding statement proves that uniformity of Customs duties on colonial and foreign products alike was not part of the free trade policy adopted by Parliament between 1842-46. It was a subsequent development of that policy, and only finally carried into effect in 1866. Several Powers still place their colonial trade on a preferential footing. It is further to be remembered that colonies not being "third" or "foreign" countries, to which countries the engagement of the most favoured nation treatment article in commercial treaties applies, international law, as well as international usage, authorises preferential treatment of colonial trade. The action, therefore, of any foreign Power which subjects colonial produce to differential treatment, on the ground that a particular colony affords preferential treatment to the goods of the mother country, or of another colony, is a new departure in international transactions, and at variance with the comity of nations.

At a conference of the Premiers of the self-governing colonies held in London, in 1902, the following resolutions were agreed to:—

(1) That the Conference recognises that the principle of Preferential Trading between the United Kingdom and His Majesty's dominions beyond the seas, would stimulate and facilitate mutual commercial intercourse, and would, by promoting the development of the resources and industries of the several parts, strengthen the Empire.

(2) That this Conference recognises that, in the present circumstances of the Colonies, it is not practicable to adopt a general system of Free Trade as between the Mother Country and the British dominions beyond the sea.

(3) That with a view, however, to promoting the increase of trade within the Empire, it is desirable that those Colonies which have not already adopted such a policy should, as far as their circumstances admit, give substantial preferential treatment to the products and manufactures of tbe United Kingdom.

(4) That the Prime Ministers of the Colonies respectfully urge on His Majesty's Government the expediency of granting in the United Kingdom preferential treatment to the products and manufactures of the Colonies, either by exemption from or reduction of duties now or hereafter imposed.

(5) That the Prime Ministers present at the Conference undertake to submit to their respective Governments at the earliest opportunity the principle of these resolutions, and to request them to take such measures as may be necessary to give effect to it.

There is no reason to believe that public opinion in the colonies is adverse to the policy enumerated in these resolutions. Some adverse speeches of private irresponsible persons, made for party purposes, in one or two colonies, and in this country, cannot be weighed against these official representations, which have not in a single instance been disavowed. It must further be strongly urged that the position of India and of the Crown Colonies in these matters, although less articulate than that of the self-governing colonies, is equally important.

The delegates of the Chambers of Commerce of the Empire, at their meeting held at Montreal last August, unanimously adopted the following resolution upon the suggestion of Lord Strathcona:—

"It is resolved that, in the opinion of this Congress, the bonds of the British Empire shall be materially strengthened and the union of the various parts of His Majesty's dominions greatly consolidated by the adoption of a commercial policy based upon the principle of mutual benefit, whereby each component part of the Empire would receive substantial advantage in trade as the result of its national relationship, due consideration being given to the fiscal and industrial needs of the component parts of the Empire.

"That this Congress urges upon His Majesty's Government the appointment by them of a special commission, composed of representatives of Great Britain and her Colonies and India, to consider the possibilities of thus increasing and strengthening the trade relations between the different parts of the

Empire and trading facilities within the Empire and with foreign countries."

Put into few words the Colonial questions to be dealt with now, are: (1) If free trade cannot be established now throughout the Empire, the proposal is, by means of tariff revision, to encourage trade between different portions of the Empire, and to make this trade as free as possible; (2) To defend those portions of the Empire which have been subjected to hostile fiscal treatment by certain foreign countries, on account of preferential treatment accorded by one portion of the Empire to another, from the injurious effects of such hostile treatment.

Whether we like it or not, or whether or not theories recognise the fact, certain of our colonies do, at the present time, come within the sphere of the controlling commercial influence of foreign Powers; and similar conditions will, before long, affect other colonies which are as yet exempt from these influences. These political grounds for action require attention from us, more especially in view of colonial expansion on the part of the leading Powers—development which it is not within our capacity to avert. We must reckon with these events, and shape our policy so that they shall neither takes us by surprise, nor occasion loss to the Empire.

The Present Question.

The preceding investigation of the facts and principles which make up the fiscal problem now before the country shows that certain economic questions affecting public interests requires very careful and unprejudiced attention. And that the result may, perhaps, be to prove that action by the State is necessary, in order to remedy the difficulties which now exist; and to adapt British fiscal policy to the altered circumstances of the present time.

Four leading facts have, it is believed, been established in the preceding pages:—

1. There has been a continued contraction of our home food supplies; a state of things unsatisfactory from a material point of view, and opposed to the political and moral interests of the kingdom.

2. Our export trade to many valuable markets, especially in manufactured goods, has fallen off; and if existing conditions remain unchecked this decline will become more acute.

Concurrently, the proportion of the population which derives its subsistence from the soil, or from finished products, has diminished, To the individual workman or capitalist it may be personally indifferent whether income is derived from coal mines, from machinery to be set up in foreign mills, or from various processes of manufacture carried on inland. From the point of view of the employment of the people, however, the latter are more beneficial and important than the former.

3. The colonies have now raised certain definite questions which must be considered and decided by the country.

4. The last urgent cause for fiscal enquiry and action is that a revision of Customs tariffs is now taking place on the continent. This revision requires attention as to (1) the classification of goods; (2) rates of duties; (3) allowances for tare, and (4) Customs regulations generally. There is reason to fear that the adverse effect of continental tariffs towards British trade since 1882 will shortly become still more detrimental. Should the general tenour of these arrangements continue to be unfavourable, and under existing circumstances there is no reason to anticipate any other result, the most favoured nation clause will, as at present, merely prevent separate and specific differential treatment of British goods in foreign tariffs, and will not confer any direct advantages or security. This being the position of the case at the present time, we come to the proposals before the country. Mr. Balfour, in his speech at Sheffield on the 1st of October, after explaining that he put aside the fiscal controversy of 1846, went on to say:—

"I will imagine the question put to me, 'Do you desire to reverse the fiscal tradition, to alter fundamentally the fiscal tradition which has prevailed during the last two generations?' Yes, I do. 'And how,' I imagine my questioner going on, 'do you propose to alter that tradition?' I propose to alter that tradition by asking the people of this country to reverse, to annul, and delete altogether from their maxims of public conduct the doctrine that you must never put on taxation except for revenue purposes. I say distinctly that, in my judgment, the country ought never to have deprived itself of that liberty, and it ought publicly to resume in the face of Europe and the world that liberty of which it deprived itself. Of course that liberty so resumed may be abused; I do not doubt it. It may get into incompetent hands; but it should be resumed. This country should again have what every other country in the world possesses, and that of which no other country in the world would think of depriving itself, the liberty to negotiate and something to negotiate with. The next question I can imagine being asked of me is, 'Why do you want

to resume this liberty of negotiations, seeing how well the country has prospered for all these years without it?' To that my reply is, I hope, explicit and distinct. My object is to mitigate, as far as circumstances allow, the injury done to us by hostile tariffs. Those hostile tariffs have inflicted upon us injury of a double kind. They have divided one fragment of the Empire fiscally from the other. They have diverted our industries into channels into which they would never have naturally flowed, they have restricted and hampered our export trade, and their effect has acted and reacted over the whole community—the community of consumers, the community of producers for home consumption. These are the evils, and, in addition, there is another evil, the insecurity which, I fear, some great branches of our industry suffer, and must suffer so long as we permit protective duties, in combination with trusts, to pour into this country at an unnatural price goods which, under a true system of free trade, under a system, I mean, in which every country produces according to its natural capacity, would never be able to compete with and never be able to outstrip the industries of home origin. Will the remedy be complete? Two other questions, and only two others, have to be asked. 'Will the remedy you propose be complete?' To that I answer it will not be complete, even if it can be tried in its integrity; and it cannot be tried in its integrity, because I believe the country will not tolerate a tax upon food. And if the last question be asked me, 'Then do you think it is of any value?' to that I reply with equal clearness, emphasis, and decision undoubtedly it will be useful. There have been plenty of occasions in the past, and, believe me, there will be plenty of occasions in the future, when a British Minister having to conduct a great commercial negotiation will feel his hands strengthened, will feel he is indeed able to represent the interests of the great country whose foreign affairs he has to manage, if he can say to the Minister of the country with whom he is negotiating, 'We do not ask you to reverse your commercial policy, we do not ask you for anything which is impossible, but common justice and common fair treatment we do ask, and if we do not get it we will take our own measures.'"

Mr. Balfour's speech combines two main points: first, to reverse the policy that taxation shall be levied solely for revenue purposes; and secondly, the adoption of measures to mitigate the injury now done to us by hostile tariffs, and hostile trade combinations.

Mr. Chamberlain in his speech at Glasgow on the 6th of October, sketched the outlines of the new fiscal policy which he advocated. His proposals are summarised in these words in the *Times* on the following day:—

"He asserted that the trade of the United Kingdom had been practically stagnant for the last 30 years. Our export trade had increased in that time by 20 millions per annum, against 110 millions in the case of the United States and 56 millions in that of Germany. The character of British trade had also changed; we were exporting less and less of manufactured goods, and importing more and more. Our exports to foreign countries had decreased by 46 millions, but those to our Colonies had increased by 40 millions. Our Imperial trade would decline unless we took the necessary steps to preserve it while there was yet time. There was still a great deal of trade with the Colonies which we could maintain and increase, and we should ask the Colonies to let us supply them with the products of industries that had not yet been created there. The Colonies were prepared to meet us; for a moderate preference they would give us substantial advantages, and he calculated that we should capture 26 millions of foreign trade to our Colonies. Such a preference would give employment to three-quarters of a million workmen, aud that would mean subsistence for nearly four millions of our population. Dwelling on the proofs recently given by the Colonies of their loyalty and devotion to the Mother Country, he asked if such a glorious inheritance was not worth preserving. We must either draw closer to the Colonies or drift apart. He emphatically stated that he did not propose any tax on raw material, but if we desired to gain the Colonies and prevent separation we must put a tax on food. The rough plan of his proposal was a two-shilling duty on foreign corn, and no duty on corn from British possessions; no duty on maize; a corresponding tax on foreign flour; a 5 per cent. duty on foreign meat and dairy produce, with the exception of bacon; a substantial preference to colonial wine and fruit, and the remission of three-quarters of the duty on tea and half that on sugar, with a corresponding reduction on coffee and cocoa. The new duties would cost the agricultural labourer $16\frac{1}{2}$ farthings a week, and the artisan $19\frac{1}{2}$ farthings, but the duties taken off would amount to 17 farthings in the case of the artisan. He estimated that the loss to the Exchequer under his scheme would be £2,800,000 per annum, but he proposed to get back that and more by what was sometimes called retaliation and sometimes reciprocity. A 10 per cent. tax on foreign manufactures would yield nine millions a year, which might be used for a further reduction of the taxes on food, and also of other taxes which pressed hardly on the community."

The two schemes are not identical in their terms, and can be taken separately. It will, however, be most convenient to consider first the objections which apply to both, and then the objections which are urged against the proposal to grant preferential treatment at home to colonial products and in the colonies to our home products.

It is alleged, first, that the present industrial and economic position of the United Kingdom is fairly satisfactory, and therefore the fiscal

question need not have been raised. I think, however, without prejudging the decision, that the grounds above set forth in support of an examination of the question, namely, the position of the agricultural interests and of our export trade and colonial wishes, and the approaching revision of foreign tariffs preclude either a direct negative or "the previous question" being a proper reply to the suggestion that Mr. Balfour's and Mr. Chamberlain's proposals shall be examined and considered. It is next urged that these proposals are opposed to free trade, which is the settled fiscal policy of this country, and must lead to international bargaining which is bad in principle. It is the fact, however, that all international engagements are contracts, and partake of the nature of bargains. This has been especially the case with commercial treaties from the earliest text we possess, that of the treaty of 509 B.C., between Carthage and Rome, to the present time. The Cobden Treaty of 1860 is a "leading case." If other countries adopt this policy, and we stand aloof, our trade will inevitably suffer, as it does now on the Continent. Even if every country settled its Customs duties by legislation, apart from negotiation, the United States tariff shows that we should not necessarily gain thereby. It must likewise be remembered that in foreign trade exporters require the certainty of fixed tariffs for the security of their transactions. We need not be apprehensive lest new taxes should be imposed in England without discussion. As regards the counteraction of hostile proceedings on the part of other countries, Mr. J. S Mill, in his work, "Laws of Interchange between Nations," wrote "The only mode in which a country can save itself by being a loser by the duties imposed by other countries on its commodities, is to impose corresponding duties on theirs. Only it must take care that these duties be not so high as to exceed all that remains of the advantage of the trade, and put an end to importation altogether; causing the article to be either produced at home, or imported from another and a dearer market." Mr. Morley, in his "Life of Cobden," in comments upon the Treaty of 1860, says "The decisive consideration is that we can only procure imports from other countries on the cheapest possible terms on condition that those countries are able to receive our exports on the cheapest posible terms."

Prince Bismarck, in a memorandum dated October 13th, 1875, expressed his opinion "that nothing but reprisals against their products will avail against those States which increase their duties to the harm of German exports." On the principle which underlies this part of the question, Mr. Gladstone's advice may be cited "if you want to benefit the labouring classes and to do the maximum of good, it is not enough to operate upon the articles consumed by them, you should rather operate upon the articles that give them the maximum of employment." (Morley's "Life of Gladstone," vol. 2, p. 57.) Further, Mr. Cobden's words, relative to the state of affairs in 1842, are equally applicable to the present conditions of some trades. "We are sowing the seeds broadcast for a plentiful harvest of workmen in the Western world," .... "they are going in hundreds and thousands to those States to open works against our own machines, and to bring this country to a worse state than it is now in. There is nothing to atone for a system which leads to this." Some expressions used here are those of a Parliamentary speech; but it fits in with the position of affairs in which British manufactures are compelled, in order to carry on business, to erect factories in foreign countries, and to induce their workmen to leave their English homes for new abodes in foreign towns.

As regards tariff wars, we do not possess full information respecting the events of recent years. While recognising that in principle retaliation is permissible, and that to allege that it is an impracticable policy is at variance with facts, it should be considered in each instance whether and how far this action is expedient in itself; and, if an affirmative opinion is formed, to what extent this action is feasible. The conclusion depends upon the answers to these two inquiries. As regards the fear which has been expressed lest foreign Powers should retaliate in their turn, as was the case in some instances mentioned in this paper, while this contingency should not be overlooked, and its possible effects duly reckoned, yet, in all matters affecting foreign relations, care should be taken not to use language for party purposes which will prejudice interests already injured by hostile tariffs or trade combinations. It is to be remembered that it has been proved that the reform of continental Customs tariffs after 1860 was effected by the coercive action of the French Government in withholding (until satisfactory arrangements were come to) the benefits of the Cobden Treaty tariff; this

reform was not effected by reasoning upon free trade nor by the gratuitous concessions of our tariff. The reciprocity provisions of the McKinley legislation of 1890 have also been very efficacious in opening markets to United States goods, and in extending their trade. The Executive in the United States possesses also a general power "whenever and as often as the President shall be satisfied that the Government of any country producing and exporting" certain specified goods, "imposes duties or other exactions upon the agricultural or other products of the United States, he may deem to be reciprocally unequal and unreasonable" to penalise their exports to the States.

In the twenty years during which I had personal cognisance of these negotiations, foreigners were often apprehensive of British retaliation. The value of British markets are fully realised abroad; and provided due caution is observed, in my opinion the good results likely to follow by release from present restrictions would outweigh any possible adverse results, which in our case would in any event be of only a transient character.

It is further alleged that the proposed new policy will bring back in thls country the evil condition of things which existed previously to the reform of the Customs Laws. It has been shown, however, that circumstances independent of these reforms had much to do with the improvement in industrial and economic conditions after 1842. But it is not in any way proposed (as I understand) to revert to the Customs system in force here previous to 1842. The Continental countries which have gone back from the policy of 1860, have not reverted to the anterior Customs system; their present tariffs, although protectionist and adverse to British trade, are much better than those in force in 1860.

The last general objection to be noticed is that the new fiscal system will increase Parliamentary difficulties, and will lead to Parliamentary corruption. It does not, however, seem possible to predict the exact shape which new Parliamentary difficulties will take —in some form or other they always exist, and it is part of the business of statesmen to surmount them. As regards Parliamentary corruption, the case is probably overstated—like many general statements made in England in public discussions. It is not proved on the Continent as an influence which affects the administration; and evils, alleged to exist in the United States, are to be attributed to combinations and trusts rather than to the regular protectionist policy of the Republic.

Turning now to objections against the proposed colonial preferential system, it is urged—

1. That it has been already tried and has failed. The fact is, however, that it did not "fail;" when duties were remitted on articles of which the colonial supply formed a portion of imports, the preference accorded to these colonial products of course came to an end.

2. That it will loosen and not strengthen the ties between British foreign possessions and the United Kingdom. This contingency is a caution rather than an objection; and it is to be expected and hoped that if the country adopt the proposed new system in principle (which on this point is in compliance with the formal application of the duly constituted representatives of the self-governing colonies, all matters that may present difficulties, or possible misunderstanding, will receive adequate attention, and be fully considered and safeguarded.

3. That if it leads to an extension of colonial trade, as is intended, the result will be that the basis of taxation will not be broadened—which is an object in view. This point is a matter which may come up for attention in the future, but does not require attention now.

4. That the proposed tariff revision must include food, among duty paying goods, and therefore it will increase the cost of living in this country. It is part of the proposal that duty shall be levied on certain articles of food; but if the rates of duty are not high, it is quite possible that no permanent increase will ensue, and in any case it will be small; and it will be counterbalanced by gains in other directions. Further (as it is expected will be the case), if employment is enlarged, the country will gain, and not lose, by this policy.

5. That the policy of preferential treatment is specifically injurious to the cause of free trade both in the colonies and at home. The fact is, however, that if Customs tariffs exist within a State, and for fiscal reasons it is not possible to establish free trade between different parts of these dominions, it cannot really be said that to charge duties on the products of one part of the Empire imported into another, lower than the rates charge upon the like goods of foreign origin, is opposed to free trade. To bring the conditions of trade between the United Kingdom and Australia and Canada, nearer to those of trade between Cornwall and Caithness, rather than those of trade between the United Kingdom and

France, Germany, or the United States, is an approximation rather than a hindrance to free trade within the Empire. This course cannot surely be said to be an evil in itself, and to be opposed to public interests.

6. Lastly, it is urged that this system of preferential trade will not benefit this country; that colonial manufacturers will still be protected. We cannot desire Colonial Governments to do what in colonial public opinion would be regarded as a sacrifice of their industries: reduction of duties cannot fail, however, to benefit our manufacturers and our export trade to some extent, in their competition with foreign traders.

It is to be remarked with regard to all these objections, that not one of them is of a constructive nature. No aid is afforded towards the settlement of the discussion before the country. Some speakers simply recommend that the existing state of affairs shall be let alone. The grounds which now call of action, the validity of which it is hoped has been satisfactorily established—namely, present economic conditions, the formal requests of the Colonies, and the position of foreign tariffs—under mere inaction an unsound policy. Some form of better education seems to be the only definite alternative policy which is offered. This Society fully appreciates the value of improved education. I have been a member of our Examinations Committee for many years; and the fact that last year 17,000 students entered for this Society's examinations proves that much work is already done in this direction, and that it is appreciated. But education in itself does not cover the ground of the present discussion. The education of the school is a preliminary stage, and leads up to the instruction to be acquired in the workshop or in the office. Education is an aid of much value, but in itself it is on a different plane from the conditions which govern the commercial, industrial, and economic position of a country. If we hold that in the existing state of things, action by the State is needed, we must deal with the proposals before the country. These proposals should be considered fairly on their merits, and not be put aside, either by irrelevant arguments, inadequate counter schemes, or simple disregard of the appeals of public interests. Assuming then, in proceeding with the consideration of the subject, that these proposals may, in principle, be admissible, it yet remains to be decided whether they are advisable and feasible. Suggestions in favour of an affirmative reply, in principle, have been submitted; but the details of the policy to be adopted are not yet worked out and placed before the public. Our functions here are limited to some few aids towards the ultimate decision. As regards foreign countries, we only claim to exercise ourselves rights and powers which they exercise. As regards the colonies, confirmation, where it has not already been given, is wanted from the proper constitutional authority of the principles laid down in the resolutions of 1902 of the premiers of the self-governing colonies.

In connection with any revision of our tariff, I would repeat an observation made by Mr. Gladstone that, "In levying Customs duties we have often before us only a choice of inconveniences; and the real question is not whether inconvenience exists, but whether it is of such an amount as to form a material hindrance to the particular branch of trade." The adoption of the following rules would seem to serve the purposes for which such revision is now required, both in the United Kingdom and the colonies.

First, that the tariff should be fairly *short*, the number of articles included in it being limited as far as possible;

Secondly, *simple*—easy to be understood by traders and by revenue officers;

Thirdly, *fair*—the rates of duties not to be exaggerated in amount.

Fourthly, *remunerative*—the rates of duties in amount, and as regards the goods on which they are to be levied, not to be so high as to lead to smuggling, nor to call for any compensatory excise charges on home products, which are vexatious and a hindrance to trade, and also costly in application. A leading principle in framing a Customs tariff should be to bring in the largest revenue with the lowest expense in collection.

It does not seem that there would be any serious difficulty in expanding and revising the tariff of the United Kingdom by means of these rules to the proposals now before the country.

It would seem that the whole subject will soon have been sufficiently argued, and that trade interests will demand an early settlement of the controversy. The question is—the re-adjustment of British tariffs—home and colonial—to meet present requirements; namely, to supply revenue; to broaden the basis of taxation; to develop colonial trade; to defend our agricultural and manufacturing interests; to safeguard the home

markets against hostile tariffs, as well as irregular trade operations; and to recover fair access to foreign markets. This policy is defensive, not offensive; it is not contrary to free trade in its original lines, nor to international law or usage. The stability of a State whose commercial prosperity is the main basis of its security, depends upon the continuous operation of the causes which have given rise to that security; and under present conditions, in our case this continuance is precarious. It is against all the experience of nations that any Power can long remain great which does not possess, or having once possessed has lost, a hardy and abundant rural population. It would be well, if even at this stage of the controversy, it could be removed out of party politics. Our aim in this Society is to deal with facts and the realities of things—to promote the welfare of all classes in the communities within the British dominions, and to maintain the complete integrity of the Empire. In the course of years, altered circumstances require alterations in public policy. History abounds in records of such changes. We must beware lest we repeat in another form the great error of the 18th century—lest by incapacity, negligence, or party blindness, we disregard the aspirations of the Colonies, and allow the influences which are now at work to bring them under other commercial connections. The Colonies are sensitive about the disparaging remarks of English politicians; and about the habit of making questions, which are of vital importance to them, bye-words in English party politics. The political conditions of the 20th century are not likely to enable those who will come after us to retrieve errors which shall have diminished the great inheritance of the United Kingdom, India, and the Colonies, which has been confided to our generation.

In the words of Mr. Froude "it may be difficult, but it surely cannot be impossible, to unite the energies which are now exhausted in neutralising one another; and to make available such political intelligence as we possess to promote the great interests of the Empire."

DISCUSSION.

The CHAIRMAN said before calling for a discussion on Sir Charles Kennedy's paper, he felt that he must give some expression to the thought in all their minds of the greatness of the loss suffered by the Society through the death of Sir Frederick Bramwell. He would not attempt to supplement in any way the obituary notice of Sir Frederick Bramwell by their scholarly and accomplished Secretary, Sir Henry Trueman Wood, which would appear with Sir Charles Kennedy's paper in next Friday's issue of the *Journal*. But having had the honour of serving on the Council of the Society for twenty-five years with Sir Frederick Bramwell, he was enabled to say with some authority that there was no member of the Society, since Sir Henry Cole, who had contributed more to its credit and reputation than Sir Frederick Bramwell. His authority over his colleagues had always been absolute. As Sir Owen Tudor Burne once felicitously said in that very room, they all looked up to Sir Frederick Bramwell as their "Grand Old Man." His influence over us was based not only on his professional eminence, and his sound judgment and good counsel in all business matters connected with the Society, or on his genial humour and ready wit and generous considerateness in social intercourse, but above all on the tried worth and loyalty of his sterling English character. And he was furthermore, physically, a splendid specimen of the race:—which, for him and every Englishman who has seen the working of the British *raj* "beyond seas," is always an item, however unconsidered at home, to be grateful for, not only from the artists' point of view, but from the patriots'. His old colleagues on the Council, felt his death as a personal sorrow, and it made a gap in their lagging lives, which could never be filled up. The Chairman continued:—He felt in an entirely false position taking the chair at that meeting. He was not only altogether unworthy to preside over a meeting which was to be addressed by Sir Charles Kennedy, but he was utterly ignorant of the subject of his paper. He had been told by those who, in such matters had to be obeyed, that the reason for his selection as Chairman was that he had an impartial mind on the subject. The truth was he was deeply prejudicied on it, as men generally are on subjects of which they are profoundly ignorant. From the riotous days of the late thirties and early fifties he had been —by force of popular sympathy — not only a Free Trader, but "a devil of a" Free Trade. But the meeting might rely on his keeping the balance of the discussion that evening quite even; and if anything would help him to do so with satisfaction to all present, it was the exemplary scientific spirit and masterful manner in which Sir Charles Kennedy had dealt with the wide-reaching, complicated, and momentous question now before the whole country and Empire, and which he had expounded to them as a basis of academical debate. The paper, so far as he might venture to judge of it, from the stand-point of "the general reader," was all that they might rightly anticipate from a gentleman of Sir Charles

Kennedy's trained and matured learning. From his university days at Cambridge he has been distinguished for his knowledge of political economy, while in the service of our Foreign Office he has had a life-long experience of commercial negotiations, and a close and full insight of the intentions and policy of foreign countries in fiscal matters, and of their attitude in regard to economic questions. It was to Sir Charles Kennedy, indeed, that were entrusted the direct, personal negotiations of the French treaties of 1872-73.

Mr. CRAIG-BROWN said that as a member of a Chamber of Commerce, and one who was very much interested in one of the largest textile industries of the country, he had frequently had an opportunity of coming in contact with Sir Charles Kennedy when he was commercial head of the Foreign Office, and he knew no man in Great Britain who was more competent to give an authoritative opinion as to the effects of tariffs upon the commercial trade of the country than he. He thought he would best consult the wishes of the audience if he gave them an account of how foreign tariffs affected the trade to which he particularly belonged, the woollen trade of the South of Scotland, and more especially the part which made Scotch tweed. The effect of foreign tariffs upon the woollen trade of South Scotland had been simply disastrous. The amount of goods now exported to the United States of America compared with the exports before the high tariffs were imposed hardly amounted to 5 per cent., *i.e.*, for every 100 pieces of goods that were sent to America before the high tariffs were put on, not five pieces were sent now. A great number of the large factories, not only in the South of Scotland, but also in what was known as the hill districts of Scotland, had been dismantled; and he thought he was not exaggerating when he said that at least 200 sets of wool carding machines, each capable of turning out £5,000 worth of goods per annum, had disappeared from that part of the country altogether. The population of Galashiels and Hawick numbered, some years ago, about 17,000 each, but Galashiels at the last census showed a loss of 4,000, and Hawick of 2,000 or 3,000 in its population. Those facts, he ventured to think, were not only serious in regard to the trade of the particular district, but also when one thought of the same thing happening in other portions of the kingdom. The effects of the continental tariffs had not been quite so disastrous as the American, but they had, nevertheless, been very serious. The trend of things showed that while English exports of wool to the continent had decreased by millions the English imports of wools from the continent had increased by millions, which meant that very large numbers of the population of this country had been thrown out of employment, with its corresponding privations. That had led not only to the loss of very considerable capital in the country, but, what was much worse in his opinion, to the transfer of capital to other countries for the purpose of providing employment in those countries, which should have been provided in our own. As the writer of the paper had intimated, there were several proposed cures for the existing state of affairs. There were gentlemen, generally barristers, who told the manufacturers of the country that they did not know their business, and that they had to educate themselves to a much higher extent than they were at present, and that what they needed was not a tariff but technical colleges. He was a manufacturer, and had been abroad a great deal and seen mills at work on the Continent, in France, Germany, and Italy; and he did not hesitate to say that the equipment of the woollen mills in this country was not only equal to the equipment abroad but immensely superior to it. There could not be a better proof of that than the fact that the mills on the Continent depended for their finest styles of Scotch tweeds, not upon their own superiority of design, but upon the patterns made in the South of Scotland and in Yorkshire. Therefore it was not deficient education which was the cause of the decline of the industry he had mentioned. He was perfectly certain that education would have no effect whatever against a tariff in France, Belgium, or Germany. He thought there was one cure for that state of affairs, viz., that the English manufacturers should have in the foreign markets the same chance of selling their goods as foreign mauufacturers had in ours, and the only way in which that could be obtained was by putting a tariff upon goods coming from other countries. English manufacturers were men of business. Commercial treaties were matters of business; and the only possible way they could get people to deal fairly with them when engaged in commercial duties, was to have in their hands weapons of the same kind as were used against us. The fact was at present before them, that in Germany and Austria very considerable augmentations of the present duties were proposed. As a member of the Commercial Intelligence Committee of the Board of Trade, he could not repeat in full what he knew in that connection, but he did not think he would be divulging any secret when he said that the Committee on the previous day had before them the answers given by Chambers of Commerce and other interested bodies throughout the kingdom in regard to the effect of the proposed new duties in Austria and Russia, and the absolutely unanimous opinion was, that while the present duties interfered most seriously with the various trades, the proposed duties would go a long way towards making trade absolutely impossible. Were they to go on as they were doing at present; were they to stay their hands and allow foreign countries to do everything they couid to kill British commerce, and, at the same time, to keep open British ports for the surplus goods of the makers abroad? He thought it was high time they ceased to stand in the open to

be shot at by men who were themselves defended by their own hostile tariff bastions; it was high time the people of the country ceased being the martyrs of an exploded dogma, and became champions of liberty in commerce throughout the world, as well as in law and in religion.

Mr. HAROLD COX, secretary of the Cobden Club, after expressing his thanks to the author for the paper, said that Mr. Craig-Brown had described, in feeling language, the injury that had been done to his trade by American tariffs, but did not give the slightest inkling of the means by which that injury was to be got rid of. The injury was that the Americans refused to buy Mr. Brown's productions. He talked generally of retaliatory tariffs, and of putting a wall round ourselves, corresponding to the wall which foreign makers had round them, but he did not explain how we, by building any number of walls, could compel the American people to buy Mr. Brown's stuff. Mr. Brown seemed to assume that England had merely to talk of retaliation, or even to put it into force, to compel other countries at once to drop their tariffs against our goods. The whole experience of the world was against that idea. This country had not always been a free trade country; it had only been a free trade country for a short time; and until it was a free trade country it was constantly trying Mr. Brown's panacea. Many persons would remember the famous speech in which Sir Robert Peel said that he personally had tried for 20 years, and found it was utterly impossible to get any satisfactory terms out of foreign countries. England was always threatening foreign countries, and telling them that if they would lower their tariffs she would lower her's, but she got nothing. That was the policy of the country for more than twenty years, during the intervening period from 1820 to 1840, when the country was gradually getting rid of protection. If that was the experience of our own country, what was the experience of foreign countries? They were always trying the same game, and retaliating upon one another, but did they get any reciprocal advantages which we did not get? There was absolutely no country in the world that gave better terms to other countries than it did to us. England had abandoned the policy of retaliation, and yet obtained as good a right of entry into every neutral market as any other country. The Germans, for instance, wished to force an entry into the French markets, and therefore they adopted Mr. Brown's policy, and put on tariffs in order to force the French to drop their tariffs. They did not succeed very much, but, as far as they did, succeed, England obtained the full benefit; it simply sat still, did nothing, and obtained every advantage which the other countries forced from one another. But England obtained more than that; at the present moment they were admitted into the French market at a lower tariff than the Americans. That experience threw very considerable doubts upon the probability that Mr. Craig-Brown's policy would be successful. Mr. Craig-Brown also implied that because he was unable to sell his stuff in America therefore the general woollen trade of England had declined, but that was not so. The test of the extension of the woollen trade was to be found in the amount of raw material worked up; there was no other possible test of the magnitude of the trade; and it was a matter of common knowledge that the amount of wool worked up in the United Kingdom had increased enormously. That could only mean that the wool spinners and weavers were more active than they were before. [A member enquired whether the increase was proportionate to the population; since the war of 1815 the population of the country had trebled; had the manufacture of clothing trebled?] He could not go back as far as 1815, but in the last 30 years the consumption of wool had increased from something like three hundred million pounds to five hundred million pounds. There was no doubt whatever that the woollen industries of the country had extended. That being so, he contended that it did not matter a brass farthing whether the woollen goods were sold to the Americans or their own people; in fact, he went beyond that, and said he would sooner sell them to his own people, because of the two he would sooner that they were the better clothed. One of the most notable facts in regard to the economic history of the past 30 years had been that owing to the cheapness of food, our own people had been able to afford better clothing. Therefore, when Mr. Craig-Brown wanted to satisfy that legitimate desire of all men, viz., the extension of his own business, the best way in which he could work for that end was by aiming, not at making the articles to be sold dear, but the articles that other people sold cheap; because if the people of the country could buy their bread cheap they would be able to afford to buy more Scotch tweed. That was a matter which was within their own control; the demand of the Americans for Scotch tweed was not. He defied any Ministry in this country to force the American people to buy Scotch tweed if they did not want to; he defied any ministry in the country to force the Americans to take off a tariff duty if they did not want to take it off, but the purchasing power of our own people was within our control, and that could be added to or diminished. Mr. Craig-Brown wanted to diminish it by taxing the food of the people of the country. So far as he did that he was diminishing the demand for his own goods. He contended that the idea of retaliation would not have the slightest rest in people's minds if they brought it to the test of a concrete instance, instead of leaving it in vague language. They had not to ask themselves whether foreign tariffs were an injury; everyone was perfectly ready to admit that they were an injury to particular traders; whether they were an

injury to the nation as a whole he was not so sure. To his mind it was arguable that, on the whole, this little country gained by foreign protection; but it was a difficult question. This country would never have been able to build up such an enormously prosperous population if it had not been that our natural advantages had been supplemented by the follies of our neighbours. Whether that were so or not, his point was that, whether foreign tariffs were an injury or a benefit to the country they were of such a nature that they could not get rid of them by any device they chose to invent.

Dr. GINSBURG was pleased that on the present occasion Mr. Cox and himself were apparently able to see eye to eye on two or three points. People very naturally looked at the Board of Trade statistics of imports and exports, and followed them as a barometer. He did not think people realised how very small a factor in our trade the foreign trade was at the present moment. Sir Robert Giffen estimated the national income of the country at 1,750 millions, which, reckoning the population of the country at 40 millions, worked out roughly at £44 a head. The Board of Trade Returns gave the total value of our exports and imports combined as about 870 millions per annum, which, if divided by the 40 millions of population, worked out a little under £21 per head per annum. He had yet to discover a trade which was all profit; therefore he thought if they took 10 per cent. of the £21, a little over £2 per head, it was a very liberal estimate. Thus the foreign trade which loomed so large in the Board of Trade statistics, only amounted to £2 per head out of the £44 per head of the population; *i.e.*, 5 per cent. only of the foreign trade of the country came into the total income of the individual; therefore, the main portion of our income evidently came from the trade we did with one another. There were no statistics available, and he did not see how there could be, which would measure that internal trade. The point he was leading up to was that every country, except our own, had its home trade preserved to it by what Mr. Cox called a tariff wall. Thanks to the machinery which was being rigged up against us by foreign nations, they were able to hit, behind their armour of protection, not merely our foreign trade, but our home trade also. He was sorry to hear what Mr. Craig-Brown said about the woollen trade, but he was still more sorry for his own trade, sugar refining, because they had not only lost their export trade, but also, to a very large extent, the home trade. One after another our trades were being attacked and cut off, first sugar, then wool, then iron. Were they, like the oysters in "Alice in Wonderland," to allow themselves to be picked off in detail, each man saying at the moment that what was being done helped him, and not caring about other people? They must put their backs together while there was yet time. He wished also to mention the shipping trade. Mr. Kennedy had alluded to the fact that the Americans had declared the trade between Honolulu and New York to be a coasting trade, and had shut out from it all foreign bottoms, thereby killing the English chance of living by that trade. Within the last few days the Americans had gone a step further, and had closed the trade between the Phillipine Islands and the ports of the United States. It was emphatically a question for statesmen—if we had any—to answer how the great question of our shipping was to be dealt with; that it would have to be dealt with sooner or later he thought admitted of no question. There was no doubt that, as at present constituted, free trade hung very largely upon coal. Mr. Thomas, in the paper referred to by the author, showed that England depended very largely for its outward cargoes upon coal, and that the country's ships would not be able to do the trade they did if the coal were not there. Indications were not wanting that our pre-eminence in coal would not continue, and he, therefore, submitted that it would eventually become a question as to whether or not England would be able to continue her present policy. In the meantime, English ships were doing a considerable trade between foreign ports, and there was a feeling amongst ship-owners that if the proposals now before the country were accepted there might be a risk that they would be discriminated against and lose that international trade. He thought those gentlemen had lost sight of the fact that the foreigners did not use our ships because they liked us, but because they were obliged to; and, not having tonnage of their own, they would not be so foolish as to say they would not let our ships carry their goods, because otherwise they would not be able to place them on the various markets of the world.

Mr. E. L. HARTLEY thought the figures Dr. Ginsburg had mentioned, in dealing with the proportionate value of English foreign trade and home trade were erroneous from the statistical point of view. Sir Robert Giffen's figure for the national income was £1,750,000,000. From the total value of the exports had to be deducted the cost of the raw material used, and the balance of the two figures was the national income derived from the export trade. The national income derived from the export trade was not 10 per cent. on the volume; it was not the profit which the capitalist made; it also included the wages which were paid in the course of making the goods. Arguing the question from the free trade basis, he asked Mr. Harold Cox to say yes or no to two questions. First, was it the fundamental axiom of political economy that everything man required should be made where it could be made with the minimum of human effort? Was not the first proposition based on this fundamental axiom that any interference by Government with the natural or economic cost of an article was a violation of the fundamental axiom, and of the economic ideal of trade? He would apply that simple proposition to England's

present fiscal arrangements, and see whether they conformed to that proposition. Taking as an instance the production of wheat in England and in the United States, the natural price at which American wheat could be sold in London was the cost of producing it in America, plus the transport from America to London. The economic cost of transport included many items, freight, and ordinary insurance, and also ought to include a contribution towards the cost of the British Navy which provided for the safety of the ships while carrying the goods to our ports. The money spent on the British Navy was often regarded as a kind of insurance upon our ocean transit, and among the functions performed by the British Navy was the defence and safe-guarding of the ships carrying wheat from New York to England, and that was part of the economic cost of delivering American wheat in the English markets. Why should not this cost be added to the price at which it was sold in England? Why should we, by throwing the whole of the burden of the navy upon home-made produce, artificially decrease the market price at which imported goods could be sold in England below the economic price by relieving them from any contribution towards the Navy which protected them while they came to our shores. The imperial expenditure was 140 millions a year. That could be raised in two ways; in the first place by making foreign-made goods come more closely to the natural price by making them contribute towards the 140 millions. If that were done we should be able to relieve the home-made goods to exactly the ame extent. The prices of the whole of the things consumed in this country have to be raised until the one hundred and forty millions a year was paid. If the whole of it were raised from home-made goods a higher price would have to be paid for them, but if part of it were raised from the foreign-made goods, the cost of producing the home-made goods was decreased by precisely the same amount. Thereby, the artificial stimulus now given to foreign-made goods would be removed, and the home-made goods encouraged; and as the generel average of prices would remain exactly the same, we should not be handicapped one jot in our competition in the neutral markets of the world.

Sir CHARLES KENNEDY, in reply, having thanked the speakers for the kind manner in which they had referred to his paper,

On the motion of the CHAIRMAN, a hearty vote of thanks was accorded to the author, and the meeting terminated.

Sir CHARLES KENNEDY writes:—I should like to add a few words on one point which (in order not to make the address longer) was not fully touched upon in my paper. This point is the insufficiency of the most favoured nation clause to safeguard all contingencies. Country A levied, very properly, a higher duty on pure wool piece goods than on mixed woollens. Country B, in commercial negotiations with A, induced A to reduce the duty on the former — being interested in that trade — and to recoup the loss of revenue, to raise the duty on mixed woollens. This change of Customs duties altered the previous conditions of trade, and hit Yorkshire manufacturers. It was known that owing to our fiscal policy and system, England could not take action to check this hostile tariff regulation. The moral is that we should not rely on "benefits" under the most favoured nation clause, but should possess the power of counter-action when it is necessary.

Correspondence.

ST. LOUIS EXPOSITION, 1904.

Would you be good enough to make a correction in your report of my remarks on page 28 of the *Journal*, in the discussion on Mr. Parker's paper on the St. Louis Exhibition. I must ask you to do this as the report gives a quite incorrect notion of what I said and is most damaging both to the architects and designers of the Exhibition and to myself.

I never stated that Mr. Kiralfy had anything to do with planning the Chicago or St. Louis Exhibitions. Mr. Kiralfy said that he had offered some suggestions to the St. Louis authorities and he was glad to see from Mr. Parker's slides that they had been adopted. But to state, as I am made to, that he had been consulted by the architects when drawing up their scheme must have astonished Mr. Kiralfy as much as myself.

I also pointed out that there was a definite idea at St. Louis—the idea of a great Italian villa—that while Chicago, the Lake City, depended for its pictorial effect on water, on the lake, by the shore of which the Exhibition was built, St. Louis typifies and makes use of the hills and forests, the main buildings being (as I am told) placed on a slope backed by woods, as at the Villa d'Este at Tivoli. These were the points that I tried to bring out, and these points (for your reporter at any rate) I failed to emphasize.

JOSEPH PENNELL.

14, Buckingham-street, Strand, W.C.
28th November, 1903.

Obituary.

SIR FREDERICK BRAMWELL, Bart., D.C.L., F.R.S. —The death of Sir Frederick Bramwell, which took place at his house in Hyde-park-gate on Monday last, November 30th, removes from the Society one

of its ablest and oldest members, and one to whose continuous and unceasing devotion the Society owes no small share of its present welfare.

Sir Frederick Bramwell's first appearance at the Society was in a discussion on a paper by the late Thomas Webster, Q.C., in 1865. Nine years later—in 1874—he himself read a very important paper on "Protection for Inventions," the discussion on which was twice adjourned, and for which the Society's Silver Medal was awarded to him. He had joined the Society this same year, and in the following year (1875) he became a member of its Council. From that time to the present he has served continuously upon it either as Ordinary Member, Vice-President, Treasurer, or Chairman (1881-1882). When His Majesty, on his accession, resigned the Presidency of the Society, which he had held since 1863, Sir Frederick Bramwell was elected to the Presidency by the Council. This election was confirmed by the Annual General Meeting in 1901, and Sir Frederick retained the office until it was accepted in December of that year by H.R.H. the Prince of Wales. In recognition of his services the Council presented the Society's silver medal to Sir Frederick in June, 1902, that medal being the first struck with His Majesty's head as Patron upon it.

Sir Frederick Bramwell also read another paper on Patent Law before the Society in 1883, as well as one on "Railway Safety Appliances" in 1876, and in 1875 he gave a Cantor course of four lectures on the "Modern Steam Engine." But his chief services to the Society were rendered in the Council room. He took a special interest in its work, was one of the most regular attendants, and his wide judgment and shrewd commonsense were always at the service of his colleagues when any difficult question arose for decision. He was also a frequent attendant at the regular evening meetings, where he very often presided and took a useful part in the discussion.

It is certain that the Society owes much of the repute and the authority it now posseses to the fact that such men as Siemens, Abel, Galton and Bramwell (to name only a few of the most prominent, and those who have passed away) were willing to devote themselves to its concerns, and among the remarkable group of men who have formed its Council for the past twenty or thirty years—to go no further back—there is no one who rendered fuller or more ready service than the one who has just left us.

Born in 1818—the same year, he was fond of reminding his friends, as that of the foundation of the Institution of Civil Engineers—he was the youngest son of Mr. George Bramwell, a partner in the firm of Dorrien and Co., bankers, of Finch-lane. His elder brother was Lord Bramwell, the Judge. His profession was marked out for him from the first, his tastes being always mechanical. In 1834 he was apprenticed to John Hague, a well-known engineer of his time. After the expiration of his indentures he became a draughtsman, afterwards chief draughtsman and then manager of different engineering establishments. He started in private practice as an engineer in 1853. Much of his early experience was in connection with steam locomotion on common roads, and he was fond of relating his experiences with Hancock and others who, in the first half of the 19th century, unsuccessfully anticipated the present application of mechanical power to ordinary traffic. But it was neither as a civil nor as a mechanical engineer that he achieved his great reputation. He soon found a career in the legal side of his profession. His marvellously clear power of exposition, his quickness of appreciation, his great readiness, his facility for rapid reply and humorous repartee, made him probably the ablest scientific witness that the courts have ever known; while in later years his great judicial powers made him in constant demand as an arbitrator.

And while his advice and help were sought by litigants in nearly all important law cases of a technical nature, his knowledge and ability were also utilised by the Government. He was one of the two lay members of the Ordnance Committee from 1881 to the present time. He reported on such subjects as the *Thunderer* explosion, and the site of the Mint, and he served on various departmental committees dealing with boiler explosions legislation, patent law, electric lighting, and the like.

One of the busiest of men—till the end of his life, after a hard day's work he would go home to work far into the night—he found time and vent for his superfluous energy in voluntary labour, which, to most men, would have supplied sufficient occupation for their whole lives. In the great institutions connected with his own profession he was for many years a conspicuous figure. He was President of the Mechanical Engineers in 1874-1875, of the Civil Engineers in 1884-1885, and both institutions relied upon his assistance to a very large extent in the management of all their business affairs. He was also a Vice-President of the Institution of Naval Architects, and served for many years on its Council. The British Association was another of the institutions in which he took a keen interest, and to which he devoted time and work. Section G—formerly Mechanical Science, now Engineering—long relied upon his help. It was in his offices that the preliminary meetings of its committee were generally held, and it was his advice that was always sought in the preparation of its programme. He was President of this section in 1872, and again when the Association visited Montreal in 1884. Four years later—in 1888—he was elected President of the Association itself, a distinction which perhaps gave him as much genuine pleasure as any of those which fell to his lot in the later years of his life. The Royal Institution too occupied for many years much of his thoughts and attention. In 1885, he became its honorary secretary, and he held this post until 1900. When the very successful series of exhibitions were held at South Kensington, Sir Frederick Bramwell served as Chairman of the

Inventions Exhibition, 1884, and this post was filled with the strenuous care which was characteristic of the man. Finally, when the City and Guilds of London Institute was formed for the promotion of technical education in 1877, he became the Chairman of its Council, as representative of the Goldsmiths' Company, of which company he was at one time Prime Warden.

That he was able to give so much time and attention to such work, was owing to the fact that he had no hobbies and no amusements. He was unhappy if he was not busy. His relaxation was only in variety of work. Life for him must be crowded with work, and such life he enjoyed to the full. Many of his intimates looked forward with some dread to the inevitable time when failing powers would enforce which he most hated, rest and quiet, and deprive him of his only solace, strenuous hard work. But that time never came. At an age when his few remaining contemporaries were at best content with a placid interest in the progress of the work they had left, he was still busy. He ignored failing powers and diminishing strength. He refused to recognise any of the signs of weakening health. Till his fatal illness seized him he was as regular as ever in his attendances at Councils and Committees. Within the past month he took part in meetings at the Society of Arts and at the Institution of Civil Engineers, and he went home late on the evening of Tuesday, the 10th November, after an unusually full day at his office in Great George-street, to be struck down by the illness which ended in his death on Monday last. So after all he died, as he would have wished to die—in harness.

H. T. W.

General Notes.

INSURANCE BUSINESS IN GERMANY.—According to an official statement recently issued by the German Government, there were 418 German and 76 foreign companies doing business in Germany in 1901. Of the whole, 355 were life assurance companies, the whole balance being composed of companies insuring against loss by fire, water, storms, accidents, robberies, &c. The premiums received by the several companies during the year were as follows:—Life, £18,162,500; fire and water, £8,265,000; accident and guarantee, £2,466,000; hailstorms, £1,187,000; cattle, £439,000; miscellaneous, £250,000. The German companies participated in these receipts to the amount of £27,956,000, leaving to the foreign companies £2,813,000.

MEETINGS OF THE SOCIETY.

Wednesday Evenings, at 8 o'clock:—

DECEMBER 9.—"Furnaces suitable for Jewellers' Work, Enamelling, Art Casting, and other similar Industries." By HENRY HARDINGE CUNYNGHAME, C.B. PROF. C. V. BOYS, F.R.S., will preside.

DECEMBER 16.—"The Science of Taxation and Business." By SIR WILLIAM HENRY PREECE, K.C.B., F.R.S. SIR ROBERT GIFFIN, K.C.B., LL.D., F.R.S., will preside.

INDIAN SECTION.

DECEMBER 10 (4.30 p.m.).—"India's Place in an Imperial Federation." By J. M. MACLEAN. SIR EDWARD A. SASSOON, Bart., M.P., will preside.

APPLIED ART SECTION.

DECEMBER 15 (8 p.m.).—"The British Silk Industry," by FRANK WARNER. SIR THOMAS WARDLE will preside. (A series of silk hangings of various periods will be exhibited on the walls of the Meeting Room).

Papers for Meetings after Christmas:—

"Ice Breakers and their Services." By ARTHUR GULSTON.

"Lessons to be Learnt from the Fire Brigade Appliances at the late International Fire Exhibition." By EDWIN O. SACHS.

"Organ Design." By THOMAS CASSON.

"Mahogany and other Fancy Woods available for Constructive and Decorative Purposes." By FRANK TIFFANY.

"Artificial and other Building Stones." By L. P. FORD.

"Thermit." By PROF. CHARLES VERNON BOYS, F.R.S.

"Steam Motors." By THOMAS CLARKSON, M.I.Mech.E.

"Early Painting in Miniature." By RICHARD R. HOLMES, C.V.O.

"Mechanical Piano Players." By J. W. COWARD.

"Agricultural Education." By J. C. MEDD.

"Garden Cities in their relation to Industries and Agriculture." By A. R. SENNETT.

"Motor Cars for popular use." By MERVYN O'GORMAN, M.Inst.E.E.

CANTOR LECTURES.

The following courses of Cantor Lectures will be delivered on Monday evenings, at 8 o'clock:—

BENNETT H. BROUGH, "The Mining of Non-Metallic Minerals." Four Lectures.

LECTURE III. — DECEMBER 7.—*Stone* :—Flint, Sandstone — Limestone — Marble — Dolomite — Slate — Eruptive rocks — Mica — Clays—Gypsum—Asbestos—Bauxite—Other earthy minerals.

LECTURE IV.—DECEMBER 14.—*Precious Stones* : —Diamond — Corundum Gems — Emerald — Other Precious Stones—Ornamental Stones—Rare Earths.

J. LEWKOWITSCH, PhD., M.A., F.I.C., "Oil and Fats—their Uses and Applications." Four Lectures.

January 25, February 1, 8, 15.

CHARLES T. JACOBI, "Modern Book Printing." Two Lectures.

February 22, 29.

BERTRAM BLOUNT, F.I.C., "Recent Advances in Electro-Chemistry." Three Lectures.

March 7, 14, 21.

The following course will be delivered on Monday afternoons, at 4.30 o'clock :—

PROF. R. LANGTON DOUGLAS, M.A., "The Majolica and Glazed Earthenware of Tuscany." Three Lectures.

April 25, May 2, 9.

JUVENILE LECTURES.

Two lectures, suitable for a juvenile audience, will be delivered on Wednesday Evenings, January 6 and 13, 1904, at 5 o'clock, on "Navigation of the Air," by ERIC STUART BRUCE, M.A.

MEETINGS FOR THE ENSUING WEEK

MONDAY, DEC. 7...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lecture) Mr. Bennett H. Brough, "The Mining of Non-Metallic Minerals." (Lecture III.)

Farmers' Club, 2, Whitehall-court, S.W., 6 p.m. Mr. W. A. Simmons, "English Agriculture."

Chemical Industry (London Section), Burlington-house, W., 8 p.m. Dr. J. Grossmann, "Cyanide Manufacture."

Surveyors, 12, Great George-street. S.W., 4 p.m. Mr. Edward Thomas Scammell, "The Preservation of Timber, with special reference to its protection from Dry Rot and the increase of its usefulness for Estate Fencing and other purposes."

East India Association, Wesminster Palace Hotel, S.W., 4 p.m. Mr. A. G. Wise, "Education in Ceylon ; a Plea for Estate Schools."

London Institution, Finsbury-circus, E.C., 5 p.m. Mr. A. Gulston, "The Ice-Breaker, 'Ermack.'"

TUESDAY, DEC. 8...Asiatic, 22, Albemarle-street, W., 3 p.m

Faraday Society, 92 Victoria-street, S.W., 8 p.m 1. Dr. R. A. Lehfeldt, "Total and Free Energy o the Lead Accumulator." 2. Mr. D. A. Sutherland, "Bitumen in Insulating Compositions." (Part 1.) 3. Mr. Sherard Cowper-Coles, "Notes on Aluminium Welding." 4. Dr. F. M. Perkin, "Electrochemical Installation at the Borough Polytechnic Institute."

Royal Institution, Albemarle-street, W., 3 p.m.

Medical and Chirurgical, 20, Hanover-square, W., 8½ p.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. 1. Discussion on Dr. Hugh Robert Mill's paper "The Distribution of Mean and Extreme Annual Rainfall over the British Isles." 2. Prof. James Campbell Brown, "Deposits in Pipes and other Channels conveying Potable Water." 3. Messrs. Osbert Chadwick and Bertram Blount, "The Purification of Water highly charged with Vegetable Matter; with special reference to the Effect of Aeration."

Anthropological, 3, Hanover-square, W., 8 p.m.

Colonial Inst., Whitehall Rooms, Whitehall-place, S.W., 8 p.m., Dr. Alfred Hillier, "Our Fiscal System."

Pharmaceutical, 17, Bloomsbury-square, W.C., 8 p.m.

WEDNESDAY, DEC. 9...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. H. H. Cunynghame, "Furnaces suitable for Jewellers' Work, Enamelling, Art Casting, and other similar Industries."

Biblical Archæology, 37, Great Russell-street, W.C., 4½ p.m.

Central Chamber of Agriculture (at the HOUSE OF THE SOCIETY OF ARTS), John-street, Adelphi, 11 a.m.

Royal Literary Fund, 7, Adelphi-terrace, W.C., 3 p.m.

United Service Institution, Whitehall, S.W., 3½ p.m. Mr. C. E. Stromeyer, "Short Service Training of Reserve Officers on the German System."

THURSDAY, DEC. 10...SOCIETY OF ARTS, John-street, Adelphi, W.C., 4½ p.m. (Indian Section.) Mr. J. M. Maclean, "India's Place in an Imperial Federation."

Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

London Institution, Finsbury-circus, E.C., 6 p.m. Mr. E. W. Maunders, "Mars and its 'Canals'"

Electrical Engineers, 25, Great George-street, S.W., 8 p.m. 1. Gilbert Tercentenary Commemoration. Presentation of an Historical Picture (representing Dr. Gilbert in the act of showing his Electrical Experiments to Queen Elizabeth and her Court) by the Institution to the Borough of Colchester, in which town Gilbert was born in 1544, and died in 1603. 2. Mr. E. Hospitalier, "The Show Registration of Rapid Phenomena by Strocographic Methods : The 'Ondographe' and 'Puissancegraphe' (Wave Recorder and Power Recorder)." 3. Dr. Hans Behn-Eschenburg, "The Magnetic Dispersion in Induction Motors, and its Influence on the Design of these Machines."

Mathematical, 22, Albemarle-street, W., 5½ p.m.

FRIDAY, DEC. 11...Tramways and Light Railways Association (at the HOUSE OF THE SOCIETY OF ARTS), John-street, Adelphi, W.C., 8 p.m. Mr. Atherley-Jones, "Protection in special relation to Tramway and Light Railway Enterprise."

North-East Coast Institute of Engineers and Shipbuilders, Newcastle-on-Tyne, 7½ p.m.

Astronomical, Burlington-house, W., 5 p.m.

Clinical, 20, Hanover-square, W., 8½ p.m.

Physical, Royal College of Science, South Kensington, S.W., 5 p.m.

SATURDAY, DEC. 12...B anic, Inner Circle, Regent's-park, N.W., 3¾ p.m.

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FRIDAY, DECEMBER 11, 1903.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

NEXT WEEK.

MONDAY, DECEMBER 14, 8 p.m. (Cantor Lecture.) BENNETT H. BROUGH, "The Mining of Non-Metallic Minerals." (Lecture IV. Precious Stones.)

TUESDAY, DECEMBER 15, 8 p.m. (Applied Art Section.) FRANK WARNER, "The British Silk Industry."

WEDNESDAY, DECEMBER 16, 8 p.m. (Ordinary Meeting.) SIR WILLIAM H. PREECE, K.C.B., F.R.S., "The Science of Taxation and Business."

Further details of the Society's meetings will be found at the end of this number.

CANTOR LECTURES.

On Monday evening, 7th inst., Mr. BENNETT H. BROUGH delivered the third lecture of his course on "The Mining of the Non-Metallic Minerals."

The lectures will be printed in the *Journal* during the Christmas recess.

INDIAN SECTION.

Thursday afternoon, December 10, 1903, SIR EDWARD A. SASSOON, Bart., M.P., in the chair. The paper read was "India's place in an Imperial Federation," by J. M. Maclean.

The paper and report of discussion will be published in a future number of the *Journal*.

JUVENILE LECTURES.

The usual short course of lectures adapted for a juvenile audience will be delivered on Wednesday afternoons, January 6th and 13th, at 5 o'clock, by ERIC STUART BRUCE, M.A., on "Navigation of the Air."

Each member is entitled to a ticket admitting two children and an adult.

A sufficient number of tickets to fill the room will be issued to members in the order in which applications are received.

Members who desire tickets for the course are requested to apply for them at once.

LIST OF MEMBERS.

The new edition of the List of Members of the Society is now ready, and can be obtained by members on application to the Secretary.

Proceedings of the Society.

FOURTH ORDINARY MEETING.

Wednesday, December 9, 1903; CHARLES VERNON BOYS, F.R.S., in the chair.

The following candidates were proposed for election as members of the Society:—

Chandler, Lincoln, Abbotsfield, Kenilworth.

Cooper, John Ashley, F.S.I., Surveyor's Office, Cooper's-hill, Castries, St. Lucia, British West Indies.

Gilfillan, Samuel, 7, Hampstead-hill-gardens, N.W., and 2, Billiter-avenue, E.C.

Loram, Albert Edmund, F.S.A.A., P.O. Box 105, Pietermaritzburg, Natal, South Africa.

Short, Thomas S., M.I.N.A., 3, Gray-road, Sunderland.

Tenison, Arthur Heron Ryan, F.R.I.B.A., 12, Little College-street, Westminster, S.W., and 19, Bath-road, Bedford-park, Chiswick, W.

The following candidates were balloted for and duly elected members of the Society:—

Ashton, Augustus George, 90, Chesnut-road, Plumstead, S.E.

Carter, Gillmore T., Dorset-house, Kingsdown, Bristol.

Gutekunst, R., 16, King-street, St. James's-square, S.W.

Higginson, Eduardo, Consul for Peru, Southampton.

Krebs, Rev. Stanley L., A.M., Greensburg, Pa. U.S.A.

Turbervill, Malcolm W., Stanwell-house, Lymington, Hants.

The paper read was—

FURNACES SUITABLE FOR JEWELLERS' WORK, ENAMELLING, ART CASTING, AND OTHER SIMILAR INDUSTRIES.

By H. H. Cunynghame, C.B.

The subject which I am about to bring to your notice this evening, is one of considerable practical importance.

Everyone who has worked at any industry in which it was necessary to heat a small piece of metal uniformly up to 1,500° Fahr. or so, knows how hard it is to arrange a suitable furnace for the purpose. If the muffle is bigger than an inch or two in width, it becomes necessary to have a chimney through which the fumes of the fuel employed may escape, and the heat given off is very unpleasant for the operator.

It is the object of my paper to show you some furnaces that I have recently invented, which are designed to obviate these difficulties.

Before, however, I describe the furnaces, it seems desirable that I should briefly describe the various furnaces that are at present in use and the fuels employed in them. In the middle ages the monks used muffle furnaces for burning in the colours and lines on painted windows and for jewellery work. Thus the Monk Theophilus in his most interesting and accurate work on glass and metal work, written about the 11th century, describes a clay furnace. (See Book II., chapters xxii. and xxiii.)

"Take flexible rods, fixing them in the earth in an angle of the house at both ends equally in the form of arches, which arches may have the height of a foot and a half, and also a similar breadth and a length of a little more than two feet. You will then beat up clay strongly with water and horse litter, so that three parts may be clay and a fourth dung. With which, being well beaten together, you will mix dry hay, making of it long flat pieces, and you will cover the arch of rods, inside and outside, to the thickness of a fist, and in the middle above you leave a round opening through which you can put your hand; make for yourself also three iron bars of the thickness of a finger, and of such length that they may traverse the breadth of the furnace, in which, on both sides, make three holes, so that you can place and withdraw them when you wish. Then place fire and wood in the furnace until it is dried."

"In the meantime make an iron tablet for yourself of the size of the furnace inside, two fingers in length and two in breadth excepted, upon which you will sift quick-lime, or (wood) ashes, the thickness of a straw, and (arrange them) with a flat piece of wood that they may lie firmly. The same tablet will have an iron handle by which it can be carried and placed and withdrawn. Lay the painted glass carefully upon it, joined together so that on the outer part, towards the handle, you place the green and sapphire, and on the inner the white, yellow, and purple, which is the most resisting against the fire, and thus, the bars being put in, place the tablet upon them. Then take beech wood, well dried in the smoke, and light a small fire in the furnace, afterwards larger, with great precaution, until you see the flame rise at the back and on both sides between the furnace and the tablet, and by passing over the glass cover it, as if in licking it, until at length it glows; immediately withdrawing the wood, carefully close the mouth of the furnace and the upper opening through which the smoke escaped, until it cool by itself. The lime and ashes upon the tablet are useful for this, to preserve the glass, that it may not be broken upon the bare (iron) by the heat. The glass being taken out, assay if you can scrape off the colour with your nail; if not, it is sufficient for it, but if you can, replace it again. All the pieces being burnt in this manner, relay each in its place upon the table; then found the rods from pure lead in this manner."...

The muffle they used generally consisted of a large iron shovel on which the work was laid. and which was covered over with a cupshaped cover with small holes in it. (Book III., ch. liv.).

"That which remains over, replace in its small cup and cover it, and do this with each colour until one piece is filled: taking away the wax, to which it had adhered, place this piece upon a thin iron, which may have a short handle, and cover it with another iron which is hollow like a cup, and let it be perforated finely all over, so that the holes may be inside flat and wide, and outside finer and rough, in order to stop the cinders if by chance they should fall upon it; this iron may also have a small ring above, in the middle, by which it may be superposed and taken off. Which being done, arrange large and long coals, making them very hot, among which you make a space, and equalise with a wooden mallet, into which the iron is raised by the handle with the pincers, so that when covered you will place it carefully and arrange the coals round and above it everywhere, and taking the bellows with both hands you will blow on every side until the coals glow equally. You have also a wing of a goose, or other large bird, which is extended and tied to wood, with which you will wave and fan strongly all over it, until you perceive between the coals that the holes of the iron quite glow inside, and thus you will cease to fan. Waiting then about half an hour you uncover by degrees until you remove all the coals, and you will again wait until the holes of the iron grow black inside, and so raising the iron by the

handle, you place it, covered as it is, in the furnace, behind, in a corner until it has become quite cold. Then opening it you take out the enamel and will wash it, and will again fill it and melt as before, and you do thus until, melted equally everywhere, it has become full. In this manner you compose the remaining pieces."

This would be a very useful and effective apparatus.

In later times however, the regular muffle furnace came into use, which every one knows, consisting simply of a fire clay receptacle which could be filled with coke with a chimney, and in the centre of which a muffle was placed. These muffle furnaces are still made, and are largely used. Excellent furnaces of this class are made by the Battersea Crucible Company of London, whose wares I would recommend to your attention.

The ancients usually employed charcoal. It is a delightful fuel. It is free from sulphur, and very easy to use, and gives great heat. Unfortunately its price renders it prohibitive in England, and I fear we must dismiss it from consideration.

The next fuel is coke. Coke consists of coal that has been highly heatad out of contact with the air. By this the gas and oils contained in the coal are driven off, and also most of the sulphur. The coal is also condensed, and remains in the form of nearly pure carbon. In this form it is called oven coke. Its heating properties are very great, and it produces a beautiful hot, even fire, which, when blown up with an air-blast, produces a very intense glowing heat. The only coke Londoners ever see, is gas coke. This wretched stuff is sold at 18s. a chauldron, and contains little but ash, the best qualities having been already extracted from it. It is almost useless for the purpose of heating a muffle oven.

I next turn to gas. In order that gas may give light, it is necessary that a supply of incandescent matter should be given to it. This may be either in the gas itself or mixed with it, as when the vapour of naphtha is added in the hydro-carbon burner, or else may be in the form of a mantle as in the incandescent burner.

But when the gas is to give heat, then what is really required is a good supply of air; about 10 cubic feet of air is wanted for each cubic foot of gas. In order to get the best results, the air must be thoroughly mixed wtih the gas. This mixing is not at all easy to effect. Air simply put in the same receptacle with gas takes a considerable time to mix. The commonest method of mixing is in the ordinary Bunsen burner. In this case the gas is supplied through a small orifice at the bottom of an open tube. As it rushes out in a jet it draws with it a stream of air, which ought to be about ten times its volume. As the gas and air traverse the tube together they become partly mixed. But they do not mix completely. The gas takes more air from the outside of the flame. The mixing is greatly facilitated if the jet of gas rushes violently. A small jet at a high pressure is what is wanted, so as to cause a good whirl of gas and air, and mix them together. This is the reason why a blowpipe is so hot. In that case the air and gas become thoroughly mixed, and a hot flame is the result.

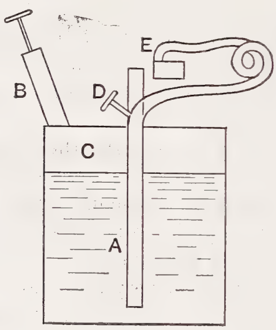
In Fletcher's gas muffle furnaces a short chimney is added to increase the draught of air. If the chimney were too long the draught of air would be too great, and then the flame would be unduly cooled. You want only ten feet of air for each foot of gas and you want them thoroughly mixed. If the flame plays into a corrugated receptacle much good is done in aiding the air and gas to mix, and a hotter flame is the result.

Petroleum is of two sorts, the ordinary lamp oil, and petrol or petroleum spirit. The last of them is used where petroleum vapour is wanted. I would strongly dissuade art workers from the use of petrol in any shape. Its vapour is inflammable and it is very dangerous; besides, in the vicinity of furnaces the reservoir is apt to be heated, and then an explosion or fire may result. All that is wanted can be done with paraffin.

The paraffin lamps most convenient for the art worker are those known as Swedish lamps (see p. 74). This lamp consists of a receptacle A filled three-quarters full of ordinary lamp paraffin. It has an air pump attached to it whereby the air above the paraffin in the space C can be compressed to a pressure of about 80 lbs. per square inch. If the tap be now opened, a stream of petroleum will rush through the pipe and issue in a fine jet from the needle-sized orifice at E.

But it is not a stream of petroleum we want, it is a stream of petroleum vapour. Hence, then, the part of the pipe between D and E is well heated by some flame, such as a gas or spirit flame. As soon as it becomes thoroughly hot, then the tap D is gently opened. A litt e petroleum gets through, which is vaporised, and issues in the form of a fine jet of vapour

from the orifice E. It mixes with air as it proceeds, and is lit, forming a blowpipe flame of intense heating power. The vaporiser tube D E is curled round as you see, so that the flame rushes through it, and thus keeps it hot and vaporises the petroleum. Of course, the vaporisation of the petroleum causes a pressure to arise in the tube D E. This is partly relieved by the jet at E; but as it cannot all escape at once at E, the rest presses back on the body of petroleum in the reservoir, and thus the pressure is maintained, so that only one blow up with the pump keeps the machine running. The real driving pressure is supplied by the heating of the vaporising chamber, the only use of the pressure in the petroleum chamber is to keep a supply of petroleum always ready to run into the vaporising chamber as it is wanted. I call this a very ingenious piece of mechanism. It acts admirably.



Petroleum, when vaporised at ordinary air pressure, occupies about 500 times its volume when in a liquid state, and requires about 5,000 volumes of air to combust it properly. A gallon of petroleum is therefore the equivalent of about 100 cubic feet of gas.

The efficacy of the flame of blowpipes of all sorts depends not only on the thorough admixture of the gas and air, but on the rapidity with which the flame rushes over the object to be heated. The use of the blowpipe therefore does not increase the total heating power of the flame, it only enables that heat to be concentrated over a small area, by causing a small but rapidly moving flame to take the place of a large slowly moving one. Hence as the object to be heated absorbs heat from the flame, the heat is constantly renewed, and the object, unable to cool the flame round it, rapidly absorbs heat itself.

Alcohol also may be used for heating. Its flame is almost invisible, because it contains no substance that, by becoming incandescent can give light. When an incandescent substance is supplied its heat is rapidly turned into light.

As in other flames, in order to get a good heat the great difficulty in the case of alcohol is to aerate your flame. All sorts of plans have been invented for this end. I have here one of the simplest that makes a capital travelling lamp. A little iron pot filled with tubes that admit air to the centre of the flame.

A furnace may be compared to a reservoir. In order to accumulate heat in it rapidly and keep the heat there, you want the heat to get in and not to get out. But an ordinary stove or furnace is a perfect sieve so far as letting out heat is concerned, and it is surprising how much heat the outside of an ordinary stove or furnace will radiate and give away by contact with the air. A long pipe that to the hand seems just hot will heat a whole room, the extent of surface making up for the low temperature. Thus an ordinary muffle furnace, supplied with six or eight large Bunsen burners, radiates away through the sides most of the heat which it receives, and makes the operator very uncomfortable in consequence.

A mere trifle of the heat given out by a kitchen fire goes to roast the meat, probably not $\frac{1}{4}$ per cent., the rest goes in making the face of the cook red and spoiling her temper.

In the course of my endeavours to invent, for the benefit of the jewellery and enamelling world, a furnace that should be economical and therefore comfortable, and be hot where it was wanted to be hot and cool elsewhere, it occurred to me to try whether the process of jacketting, which I had applied with success to household hot water-pipes, could not also be applied to furnaces. The task was not altogether easy, for most non-conductors are fusible in very hot flames.

I will not narrate all the experiments I made. I tried furnaces of every shape, opening in every sort of way, and the results are here before me.

Here I have three furnaces. They are muffles, of $1\frac{1}{2}$-inch, $2\frac{1}{2}$-inch, and 5-inch width. They are hot within; they are quite cool without. And in consequence they can be heated with extraordinarily small flames. One would hardly believe that the flames I show could keep them hot. The secret is that while the interior is of fire-clay, the exterior is thickly covered with asbestos,

Various sorts of asbestos can be used. The class used for covering boilers does very well, and is made by a number of London makers. The main ingredient is asbestos, made to adhere with a little plaster of Paris and weak glue. Of course, in my furnaces the glue soon goes on the inside, but enough plaster remains to keep it together.

In connection with this subject, I would mention "Uralite." This wonderful material is made in plates which can be screwed or nailed like wood. It is completely fire-proof. A powdered uralite is also sold which, if made up with a little water-glass, holds together very well, and forms an excellent insulator. Furnaces so made can be surrounded with uralite plates, and have a very neat appearance.

In order to apply the same principles to furnaces, I have designed a melting furnace, two of which I have here. They are heated by Swedish burners. Unfortunately, the Swedish lamps make such a noise, that for peace sake I have had to send them out of the room. I will now re-introduce them, and show you them at work. I shall in each case jacket the crucible in a sort of jug with a handle, after which I shall easily be able to pour the metal. The larger furnace contains an alloy of aluminium. [Furnaces here brought in and shown in operation.]

On the table I have put out the requisites for an enameller. I would direct your attention to a little soldering pad and cover, made out of asbestos, and painted with very refractory fire-clay. It radiates the heat well, and with such an apparatus soldering is easy. In fact work can be done that would be quite impossible without some such heat-insulating plates and covers.

It may here be appropriate to say a few words on the subject of fire-clay.

Clay is a silicate of alumina, that is to say, a compound of silicic acid, or flint, with aluminium. Most natural clays contain potash and iron. The result is that when they are strongly beaten the silicate of alumina combines with the potash and forms a small quantity of glass disconnected with the clay. For, of course, as you know, glass is a silicate of potash or soda. Hence the most refractory fire-clays are those that are free from iron and soda and potash. Fire-clays are of this description, and are frequently found in coal measures. Of all of them the best is white porcelain clay, which is a most infusible sort of fire-clay. In some parts of Germany an extraordinarily infusible sort of porcelain is found and used for chemical apparatus.

Common yellow clay, like the lump I hold here, got from my garden, can be made into very fair fire-clay by ridding it of the potash and iron. This is best done by boiling it with some diluted hydrochloric acid. In this way anyone can prepare some tolerable fire-clay for his own use. Of course the chloride of iron and potash must be well washed out of it by agitation with water.

I have here a splendid specimen of natural fire-clay, it contains iron but it is most refractory.

When a new furnace has to be treated with fire-clay, or when any object is made of fire-clay, it is necessary to mix the clay with water, and to knead it most thoroughly so as to get it uniform; it must then be left to dry slowly. Of course the outside dries first, and tends to imprison the water in the damp inside. If considerable heat is then suddenly applied, steam forms inside the mould, that is to say in the body of the clay, and being unable to escape it bursts it.

In order to avoid this, it is necessary to mix something with the clay to keep the pores open. It is of course no use to mix sand. What you want is something that can be burnt out by the heat and leave the body porous. For this purpose pieces of old fire-clay are ground up and mixed with the unfired clay. Another plan, simpler for the jeweller, is to mix the fire-clay with some sawdust. A somewhat hard dust is best—box-wood or oak dust is very suitable. In this way little plaques can be made for use in muffle ovens, or muffles can be made if needed. But it is indispensable to dry them gently, and then when dry to put them in a hot oven for some time before they are fired. This will prevent them from cracking.

All fire-clay articles should, before being subjected to a great heat, be warmed up gradually or else there is considerable fear of them flying or cracking.

In making these furnaces it is necessary to have something to bind the material together. Cowhair is not bad. In addition to this I prefer to imbed in the material some pieces of rabbit wire netting which serves greatly to strengthen it.

The process of drying the furnaces must at first be gradual and can be completed in a kitchen oven. Even after this they will still give out moisture for some time, and it is not till they have been some time in use that they

get quite dry, and their non-conducting power is fully developed. The interior lining should not be too thick, for all that is needed is a surface to resist the action of the flame; the rest should be as nonconducting as possible.

DISCUSSION.

Mr. WILLIAM BURTON thought the author had displayed an extraordinary amount of ingenuity by the method in which he had brought his principle of jacketing to bear on small furnaces. Speaking as a potter, he thought the application of the jacketing principle, either with asbestos or similar material, ought to be of the greatest value in his own trade. There was no doubt that of the coal burnt in pottery ovens and kilns in this country about 75 per cent. went to waste in one way or another. The principle of jacketing had, to some extent, already been applied in pottery ovens, and he recently saw in Glasgow, at the works of Messrs. Cochrane and Fleming, the jacketing principle applied to an oven 20 feet in diameter, which he was assured by that firm had saved the coal bill enormously. The principle adopted was of actually sheathing the oven in boiler plate, and in that practical manner a very considerable saving in the fuel had been obtained. He would send Mr. Fleming a copy of the paper, and he would probably carry his idea of jacketing a good deal further by putting inside the sheathing of iron a coating of asbestos.

Prof. W. GOWLAND said he had seen the furnaces at work in Mr. Cunynghame's laboratory, and although the laboratory was an extremely small one, the temperature of the room was never uncomfortable; it hardly rose more than a few degrees after the furnaces had been working for some time. It seemed to him that the application of the author's ingenious and simple principle to the jacketing of muffle furnaces had several very important advantages. In the first place, the jacket protected the operator, which those who had to stand a long time watching the operations would appreciate. It had the additional advantage that, for a given muffle, with a given burner, a very much higher temperature could be produced in a jacketed furnace than with the same burner in an unjacketed furnace. Thirdly, in a furnace jacketed in the manner exhibited, there was uniformity of temperature, which was of the utmost importance. In the muffles shown the temperature at the front was the same as at the back. If that principle was applied to assaying metals, for instance, gold or silver, uniform conditions would be obtained throughout the muffle, which were not always obtained with an ordinary furnace. There was a trifling disadvantage connected with silver assaying by the furnace shown, that it would take a long time to cool down, but that could be obviated by working the furnace at just the melting point of silver. There was one assaying process for which the furnaces would be extremely useful, namely, for scorification, where a higher temperature was required than for ordinary gold and silver assaying. The melting furnaces were extremely good, and just the kind of appliance wanted for certain purposes. It would be agreed that every sculptor ought to have a knowledge of the practical operations by which his model was reproduced in bronze, but hitherto there had been difficulties in the way. Firstly, it had not been convenient for a sculptor to have an ordinary coke furnace built near his studio, and certainly not in it. There was the further disadvantage that in the training of sculptors too little attention was paid to the technical operations of bronze founding. The first difficulty was got over by the apparatus shown. There was no reason whatever why the principle should not be applied to furnaces many times larger than those exhibited, furnaces which could melt 50 or 60 lbs. of bronze, and in that way a furnace would be obtained which any sculptor could have in his studio, and with a little practice he would be able to produce a casting much more satisfactory than any he would receive from an outside founder. In addition to setting up a furnace of that kind in a studio he recommended that the method of *cera perduta* should be adopted, *i.e.*, the model should be made in wax and coated with clay, the wax melted out and the bronze cast in the clay mould, heated to redness in the same way in which it was done in Japan, and then by the use of a copper-tin-lead alloy the sculptor could reproduce the most delicate touches that he had given to his wax model.

Mr. CYRIL DAVENPORT asked the author if the furnaces could be made much larger, because he thought they must necessarily be small. He also enquired whether there was any great advantage in the gas furnaces shown by Mr. Cunynghame over charcoal, which was generally used.

SIR CLEMENT LE NEVE FOSTER, F.R.S., said that having been born in the vicinity of London, he wished to say a word in defence of London coke, which had received rather harsh treatment from the author. He used 2s. worth of coke a week, which was sufficient to heat his bath water, to heat a radiator, and supply the kitchen and lavatory with hot water, and therefore he thought it was rather unfair to say that London coke was mainly composed of ash. Having at one time had a great deal to do with quantitative blow-pipe assaying, he thought the ideas brought forward by Mr. Cunynghame would be of use to all persons who were engaged in work of that description—they would be able to get their work done more rapidly, and would be able to use larger charges in the little crucibles in which the work was done, and therefore the results of the assays would be more satisfactory. The assaying process also opened up a useful educational path. There were students in many schools who would like to practice assaying

who were unable to do so because of the expense, but by using Mr. Cunynghame's apparatus the student would be able to do assaying in his spare time, and in that way the furnace presented an advantage which had not been alluded to.

Mr. ALEXANDER FISHER thought that anything which made it easier for an artist to realise what he wished than he had hitherto been able to do was a very great advantage. The feature of the furnace which had attracted him most was that it could be placed almost anywhere in the studio, and the absence of heat was also a great convenieuce. He had seen the furnaces at work at Mr. Cunynghame's house, and thought they were altogether admirable.

Mr. M. E. WILSON said he could not say more than thank the author very sincerely for the extraordinary ingenuity by means of which he had achieved his object. The furnace exhibited was exactly what people had been waiting for for years.

Mr. FLETCHER thought Mr. Cunynghame's furnace was the best he had seen during an experience of 25 years. The author deserved the thanks of all workers in metals or art works. One of the great disadvantages of gas furnaces was that many of them required a blast or else a very large chimney and a large supply of gas, which Mr. Cunynghame had reduced to the minimum. He would like to know whether there was any special formation of the roof for the furnace in relation to the muffle. He noticed that the flame had two outlets, and from his experience in experimenting with various gas furnaces of that character he found considerable difficulty owing to the shape of the roof, the distance between the roof and the furnace, and the outside of the muffle. The formation of the roof in the furnace shown was a very great advantage.

The CHAIRMAN wished to join with Sir Clement Le Neve Foster in the defence of gas-coke, but not entirely, because in a furnace it was an abomination; but if gas-coke was used for the purpose which Sir Clement had used it, for producing moderate temperatures in which the ash did not melt but could be raked out, then it was a very handy and convenient fuel. Engine coke, of course, was practically unknown to the ordinary householder. Another fuel not mentioned by Mr. Cunynghame was anthracite. In the old days, in Dr. Percy's laboratory, anthracite was used where the highest temperatures had to be obtained, temperatures capable of melting wrought iron. Anthracite was the most beautiful and perfect of all fuels in the furnace, but it could not be burnt in a furnace the size of a tumbler. A moderate-sized furnace was required and anthracite, being almost pure carbon, and wonderfully free from ash, was, as a fuel, quite unequalled among solid fuels. The author had referred to the mixing of air and gas. Anybody was apt to believe when they first used a Bunsen burner, or other apparatus of the kind, that if gas and air were fed side by side into a tube, they became perfectly mixed. Imperfect mixing of gas and air not only gave rise to the imperfect Bunsen flame, but also gave trouble in the explosion engine of the motor bicycle and motor car; and he understood some people, who were not content with the motor bicycle as it was at present, had introduced an extra bend in the gas and air supply of the engine, so that the mixture should pass through a longer distance in order to get a more intimate atomic relationship between the fuel and the air, so that when the spark was lighted there was a true instantaneous combustion passing through the whole region of the cylinder. He quite agreed with the author's remarks as to the unnecessary danger of using petrol for the purposes mentioned. Petrol was not so good a fuel as one of the higher homologues, and was quite unnecessary in view of the invention of the Swedish lamp, which enabled one to use common lamp oil petroleum without trouble, and melt metals on a small scale. It had also the advantage that petroleum was a fuel, the whole of which was good fuel, which could not be said of coal gas, or other commercial fuels, and it was also practically free from sulphur. He objected to the use of alcohol, although for domestic purposes it had the advantage that when it was lighted and put out two or three times it did not stink the place out as a Swedish lamp did, if by any misfortune the flame was blown out and could not be quickly lighted again. With regard to the author's design of furnace, he thought the whole essence of the construction depended on the proper use of non-conductivity, the use of materials that did not crack, and the grading of the qualities of the materials, from the hot zone on the inside to the cool zone on the outside. One material all through was not correct. Those who had hitherto been content to make a fire-clay furnace were met with the trouble that if it was made thick and heavy with the idea of preventing too much loss of heat, it required the most tender use to prevent it from cracking; whereas if it was made thin the heat passed through it like a sieve, and terrible variations of temperature must necessarily result on the inside where fuel was very furiously burnt to waste. The beautiful uniformity of heat obtained by Mr. Cunynghame in his furnace was quite out of the question where a furious blast was blown into the furnace, and most of the heat poured away through its thin conducting walls. He was astonished that such principles, which were well known to everyone, had not been hitherto applied by the trade which supplied furnaces to the public, he fancied mainly on the ground that the furnace shown was too big and was not a saleable article. The manufacturer looked upon the public as fair game to exploit; he made such articles as he could easily sell at a good profit, and did not make

what the public really wanted. The public wanted such things as Mr. Cunynghame had exhibited, but they had not been produced by the trade. It was not of the slightest consequence that a furnace which would melt 7 or 14lbs. of metal should not be more than 8 or 10 inches in diameter; it was of the utmost consequence that it should behave as Mr. Cunynghame's furnaces had done that evening. The members of the Society of Arts had had more than one occasion to thank the author of the paper for his ingenuity in applying principles, well-known or the reverse, to produce that which was wanted. A year or two ago he described one of the most valuable developments of a metallurgical art, viz., the method of brazing or silver-soldering by the use, not of borax in water, which frothed up and displaced the soldering material, and was generally a nuisance in the fire, but of melted borax—borax glass—ground excessively fine with petroleum or vaseline. Anyone who had used the method would wonder how it was that it was not absolutely universal, but many people seemed never to have heard of it. What Mr. Cunynghame had shown in his present paper, would be the beginning of the removal of difficulties out of the path of those who were practising, on an experimental scale, the metallurgical art, whether for artistic or utilitarian purposes.

Mr. Cunynghame, in reply to the question asked about the interior arrangement of the furnace, said that was an exceedingly important matter. He had tried many experiments for the purpose of determining the best interior form of the chamber which surrounded the muffle. The following principles should be adopted:—With a muffle up to about five inches in diameter he would not suggest, in an economical furnace, that more than half-an-inch should be left on each side; if more was used, the heat would be wasted. If the muffle was bigger than five inches, perhaps three-quarters of an inch might be left. At first he made the tops of two shapes. In one instance he tried high tops, but he found there was an enormous accumulation of hot air that rushed up the chimney and did no good, so he filled the space up with broken pieces of fire-clay material, such as was used for small gas fires. It then occurred to him that it was no use having the chamber at all, so he abolished it, and from that time the success of the furnace began. The furnaces exhibited were made with a top not more than half an inch clear all the way round, and at each end of the muffle, at the front and the back, there was a chimney duly proportioned to the size of the furnace. For a five-inch muffle, a chimney about one inch square for each chimney would carry off the flame. There was no harm in making it bigger, because if it was made a little too big it could be covered up from the top. There was the further advantage that the heat could be thrown to the front or back by covering the front or back chimney. There were various ways of putting the muffle into the furnace. In one of the furnaces he had made the top open, with a piece that could be lifted out of the centre of the furnace from the top; sometimes he had the back open, and pushed the muffle in from the back. Upon the whole, he preferred the mode where there was a block which came out from the top. The second necessity was to get a good fire-clay lining at least half-an-inch thick inside, and gradually to graduate it off, mixing more and more of the asbestos with it till eventually pure asbestos was used. The thickness was mainly a question of the temperature inside and out; for a temperature of 1500°, not less than four inches should be used. For melting cast iron, probably it would be necessary to have six or seven inches; and for one of the largest furnaces for a brassfounder, it would be necessary to have the fire-clay walls four inches thick with a foot of asbestos round them, which would make a splendid non-conducting zone, and this, after an hour or two's use would give a glorious heat. The amount of metal which could be melted with an extremely small expenditure of fuel was astonishing.

On the motion of the Chairman, a hearty vote of thanks was accorded to Mr. Cunynghame for his paper, and the meeting terminated.

Miscellaneous.

MEMORIAL TABLETS.

In 1901, the London County Council took over the work, initiated by the Society of Arts, of commemorating the residence in houses in London of distinguished persons. From a statement lately issued by Mr. Laurence Gomme, the Clerk of the Council, it appears that the necessary preliminaries in connection with the preparation of a design to be adopted for the memorial tablets, the obtaining of tenders for the work of making the tablets, and the investigation of a number of houses which it had been suggested should be distinguished, have occupied a considerable time; but now that these preliminaries are completed the work will proceed rapidly. The Council has already approved of the fixing of tablets on the following houses—

(1) Holly-lodge, Campden-hill—the house in which Lord Macaulay died.

(2) No. 122, Great Portland-street—which stands on the site of the house in which James Boswell died.

(3) No. 67, Wimpole-street—a residence of Henry Hallam.

(4) No. 48, Doughty-street, Mecklenburgh-square—a residence of Charles Dickens.

(5) No. 22, Theobald's-road—the birthplace of Benjamin Disraeli, Earl of Beaconsfield.

(6) No. 4, Whitehall-gardens—the house in which Sir Robert Peel died.

(7) No. 56, Devonshire-street, Portland-place—a residence of Sir John Herschel.

(8) No. 1, Devonshire-terrace, Portland-place—a residence of Charles Dickens.

(9) No. 12, Clarges-street, Piccadilly—a residence of Edmund Kean.

The necessary preliminary enquiries and investigations concerning a number of others are almost completed. Among the persons in commemoratian of whom it is probable that the Council will, at no very distant date, be recommended to erect tablets may be mentioned Henry Cavendish, James Clerk-Maxwell, Charles Darwin, William Hazlitt, William Pitt, Samuel Richardson, and Thomas Young. Of the tablets which the Council has already determined to erect, tablet No. (1) was unveiled on the 26th inst., by the Earl of Rosebery, thus inaugurating the Council's work in this direction. Tablet No. (4) is ready to be fixed, and Nos. (3), (5), and (6) will be ready very shortly. Since the Council determined to affix a tablet in the case of No. (2) very careful consideration has been given to the question whether it is desirable to continue the practice, occasionally adopted by the Society of Arts, of putting up tablets on comparatively new houses which occupy the sites of the actual premises in which the persons to be commemorated lived. As a result it is probable that in the near future the Council will be recommended to abandon the proposal to erect a tablet on No. 122, Great Portland-street, and to indicate instead a house actually occupied at one time by Boswell.

The procuring of the necessary consents for the erection of tablets in the cases of the above houses has necessitated a correspondence with a large number of persons having interests in the premises, aud the Council acknowledges the courtesy and consideration which have been extended to it in the matter.

The form of tablet has been designed under the direction of the Council's Superintending Architect, Mr. W. E. Riley, F.R.I.B.A., who advises the Council as to the position in which the tablets should be fixed, and under whose supervision they are erected.

MINES AND QUARRIES, 1902.

The third part of Sir C. Le Neve Foster's general report and statistics for 1902, containing particulars of output, has just been published, from which it appears that the value of the minerals produced at the mines and quarries of the United Kingdom in 1902 was £107,134,854, a decrease of eight millions compared with the preceding year owing to the reduced prices paid for coal.

The total output of coal was 227,095,042 tons, which is the largest on record, for it exceeds by 1,913,742 tons the quantity produced in 1899. Compared with the output of 1901, there is a rise of 8,048,097 tons; this increase was due mainly to the larger number of persons employed, though the slight increase of five tons in the yield per underground worker has a small share in accounting for the rise.

It appears that 166,694,908 tons were consumed in the United Kingdom, or nearly 4 tons per head of the population; 17,649,137 tons of coal were used in blast furnaces for making pig-iron.

The quantity of coal exported, exclusive of coke, patent fuel, and coal shipped for use of steamers engaged in foreign trade, was 43,159,046 tons, an increase of 1,281,965 tons compared with the preceding year, a decrease of 930,151 tons compared with 1900, which is the year with the highest recorded export.

If the quantities of patent fuel, coke and coal shipped for use of steamers engaged in foreign trade, are added, the total amount of coal which left this country was 60,400,134 tons, or about as much as the entire output of the kingdom half a century ago. The principal customers were France, which took 7,600,111 tons, Italy 5,994,910 tons, and Germany 5,835,644 tons.

MEETINGS OF THE SOCIETY.

Wednesday Evenings, at 8 o'clock:—

DECEMBER 16.—"The Science of Taxation and Business." By SIR WILLIAM HENRY PREECE, K.C.B., F.R.S. SIR ROBERT GIFFEN, K.C.B., LL.D., F.R.S., will preside.

APPLIED ART SECTION.

DECEMBER 15 (8 p.m.). — "The British Silk Industry," by FRANK WARNER. SIR THOMAS WARDLE will preside. (A series of silk hangings of various periods will be exhibited on the walls of the Meeting Room).

Papers for Meetings after Christmas:—

"Ice Breakers and their Services." By ARTHUR GULSTON.

"Lessons to be Learnt from the Fire Brigade Appliances at the late International Fire Exhibition." By EDWIN O. SACHS.

"Organ Design." By THOMAS CASSON.

"Mahogany and other Fancy Woods available for Constructive and Decorative Purposes." By FRANK TIFFANY.

"Artificial and other Building Stones." By L. P. FORD.

"Thermit." By PROF. CHARLES VERNON BOYS, F.R.S.

"Steam Motors." By THOMAS CLARKSON, M.I.Mech.E.

"Early Painting in Miniature." By RICHARD R. HOLMES, C.V.O.

"Mechanical Piano Players." By J. W. COWARD.

"Agricultural Education." By J. C. MEDD.

"Garden Cities in their relation to Industries and Agriculture." By A. R. SENNETT.

"Motor Cars for popular use." By MERVYN O'GORMAN, M.Inst.E.E.

Cantor Lectures.

The following courses of Cantor Lectures will be delivered on Monday evenings, at 8 o'clock:—

Bennett H. Brough, "The Mining of Non-Metallic Minerals." Four Lectures.

Lecture IV.—December 14.—*Precious Stones:*—Diamond—Corundum Gems—Emerald—Other Precious Stones—Ornamental Stones—Rare Earths.

J. Lewkowitsch, PhD., M.A., F.I.C., "Oil and Fats—their Uses and Applications." Four Lectures.

January 25, February 1, 8, 15.

Charles T. Jacobi, "Modern Book Printing." Two Lectures.

February 22, 29.

Bertram Blount, F.I.C., "Recent Advances in Electro Chemistry." Three Lectures.

March 7, 14, 21.

The following course will be delivered on Monday afternoons, at 4.30 o'clock:—

Prof. R. Langton Douglas, M.A., "The Majolica and Glazed Earthenware of Tuscany." Three Lectures.

April 25, May 2, 9.

Juvenile Lectures.

Two lectures, suitable for a juvenile audience, will be delivered on Wednesday Evenings, January 6 and 13, 1904, at 5 o'clock, on "Navigation of the Air," by Eric Stuart Bruce, M.A.

MEETINGS FOR THE ENSUING WEEK.

Monday, Dec. 14...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lecture) Mr. Bennett H. Brough, "The Mining of Non-Metallic Minerals." (Lecture IV.)

Geographical, University of London, Burlington-gardens, W., 8½ p.m. Colonel Sir Thomas Holdich, "The Patagonian Andes."

British Architects, 9, Conduit-street, W., 8 p.m. Messrs. Henman and Lea, "The Royal Victoria Hospital, Belfast. Its Inception, Design and Equipment."

Medical, 11, Chandos-street, W., 8½ p.m.

Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p.m. Rev. G. F. Whidborne, "The Genesis of Nature."

London Institution, Finsbury-circus, E.C., 5 p.m. Mr. A. B. Walkley, "Some Aspects of the Modern Stage."

Tuesday, Dec. 15.. SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Applied Art Section.) Mr. Frank Warner, "The British Silk Industry."

Alpine Club, 23, Savile-row, W., 8½ p.m. Annual Meeting.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. 1. Prof. James Campbell Brown, "Deposits in Pipes and other Channels conveying Potable Water." 2. Messrs. Osbert Chadwick and Bertram Blount, "The Purification of Water highly charged with Vegetable Matter; with special reference to the effect of Aeration."

Statistical, 9, Adelphi-terrace, W.C., 5 p.m. Mr. Alexander Siemens, "The Metrical System of Weights and Measures."

Pathological, 20, Hanover-square, W., 8½ p.m.

Colonial Inst., Whitehall Rooms, Whitehall-place, S.W., 8 p.m. Mr. W. L. Allardyce, "The Fijians and their Fire-walking."

Wednesday, Dec. 16...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Sir William Henry Preece, "The Science of Taxation and Business."

Meteorological, 25, Great George-street, S.W., 7½ p.m. 1. Mr. William Marriott, "Some Account of the Meteorological Work of the late James Glaisher." 2. Mr. J. R. Sutton, "Certain Relationships between the Diurnal Curves of Barometric Pressure and Vapour Tension at Kimberley, South Africa."

Geological, Burlington house, W., 8 p.m.

Chemical, Burlington-house, W., 8 p.m. 1. Messrs. J. J. Dobbie, A. Lauder, and C. K. Tinkler, "The relative Strengths of the Fixed Bases and of Ammonia as Measured by their Action on Cotarnine." 2. Mr. J. C. Cain, "New Halogen Derivatives of Diphenyl and Dihydroxy-Diphenyl." 3. Mr. E. Divers, "Constitution of Nitric Peroxide." 4. Mr. E. Divers, "Sabatier's Nitroso-Disulphonic Acid." 5. Messrs. A. G. Perkin and E. Phipps, "Notes on some Natural Colouring Matters." 6. Messrs. T. E. Thorpe and J. Holmes, "The Estimation of Methyl Alcohol in Presence of Ethyl Alcohol."

Microscopical, 20, Hanover-square, W., 8 p.m. 1. Mr. George J. Hinde, "The Structure and Affinities of the Genus Porosphæra." 2. Mr. F. W. Watson Baker, "Exhibition of a Series of Slides, illustrating the development of an Ascidian."

British Archæological Association, 32, Sackville-street, W., 8 p.m.

Thursday, Dec. 17...Linnean, Burlington-house, W., 8 p.m. 1. Mr. H. J. Fleure, "The Docoglossa; a Study in Evolution."

London Institution, Finsbury-circus, E.C., 6 p.m. Mr. A. F. Ferguson, "Christmas Song."

Optical, 20 Hanover-square, W., 8 p.m. Messrs. A. J. Bull and A. C. Jolley, "The Function of Tri-Colour Filters."

Electrical Engineers, 25, Great George-street, S.W., 8 p.m. Mr. P. V. McMahon, "The City and South London Railway. Results of the Three-Wire System applied to Traction."

Historical, Clifford's Inn Hall Fleet-street, E.C. 5 p.m.

Numismatic, 22, Albemarle-street, W., 6½ p.m.

Friday, Dec. 18...Civil Engineers, 25, Great George-street, S.W., 8 p.m. (Students' Meeting.) 1. Mr. C. B. Case, "The Action on the Sea upon the Foreshore." 2. Mr. F. W. Cable, "The Causes of the Loss of Beaches."

Art Workers' Guild, Clifford's-inn Hall, Fleet-street, E.C., 8 p.m.

Architectural Association, 9, Conduit-street, W., 7½ p.m. Mr. G. P. Bankart, "Old Stucco and Plaster Work, with reference to Modern Possibilities."

Quekett Microscopical Club, 20, Hanover-square, W.C., 8 p.m.

Mechanical Engineers, Storey's gate, Westminster, S.W., 8 p.m. Messrs. C. E. Stromeyer and W. B. Baron, "An Inquiry into the Working of various Water-Softeners."

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FRIDAY, DECEMBER 18, 1903.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

THE LATE SIR FREDERICK BRAMWELL.

At their meeting on Monday, the 14th inst., the Council of the Society passed the following resolution :—

The Council desire to place on record their appreciation of the loss which the Society has sustained by the death of Sir Frederick Bramwell, a Past-President of the Society, and a Member of Council in various capacities since 1875. The Council feel it would be difficult to overrate the services which Sir Frederick rendered the Society in the promotion of the objects for which it was instituted, or the manner in which he was always ready to devote time and thought to the advancement of those objects. Sir Frederick Bramwell had a sincere attachment to the Society, and this feeling was reciprocated by all those of its members with whom he came in contact. His colleagues on the Council regarded him not only with respect, but with a sincere affection won by his constant geniality, the kindliness of his nature, and his unfailing courtesy of manner, and they mourn the loss not only of a valuable colleague, but of a dear friend. They also desire to assure Lady Bramwell and her two daughters of their very sincere sympathy in the loss which they have sustained.

CANTOR LECTURES.

Mr. Bennett H. Brough delivered the fourth and last lecture of his course on "The Mining of the Non-Metallic Minerals," on Monday evening, 14th inst.

The Chairman (Mr. H. Bauerman) proposed a vote of thanks to Mr. Brough for his interesting course of lectures, which was carried unanimously.

APPLIED ART SECTION.

Tuesday evening, December 15, 1903, Sir Thomas Wardle in the chair. The paper read was "The British Silk Industry," by Frank Warner.

The paper and report of the discussion will be published in a future number of the *Journal.*

JUVENILE LECTURES.

The usual short course of lectures adapted for a juvenile audience will be delivered on Wednesday afternoons, January 6th and 13th, at 5 o'clock, by Eric Stuart Bruce, M.A., on "Navigation of the Air."

Special tickets are required for these lectures, which can be obtained on application to the Secretary. A sufficient number of tickets to fill the room will be issued to members in the order in which applications are received, and the issue will then be discontinued. Subject to these conditions each member is entitled to a ticket admitting two children and an adult. A few tickets still remain, and members requiring these should apply at once.

Proceedings of the Society.

INDIAN SECTION.

Thursday afternoon, December 10, 1903, Sir Edward A. Sassoon, Bart., M.P., in the chair.

The paper read was—

INDIA'S PLACE IN AN IMPERIAL FEDERATION.

By J. M. Maclean.

Plans for the establishment of an Imperial Federation which should weld together more closely the United Kingdom and its Colonies and Dependencies beyond the seas have of late years had a singular fascination for English public men. Their speculations in this direction, however, have rarely gone beyond a mere blind groping in the mist; and, while lately a scheme of a more definite character has been

placed before the English people, its limitation to the self-governing colonies alone, and the neglect of its author to take into account the position of India as by far the most important of all the possessions of the Crown, and to find a place for it in the projected federation of the Empire, has given to his scheme an air of want of thoroughness which makes it difficult of acceptance.

The Position of the Colonies.

It is easy to understand why in these later days the colonies have loomed so disproportionately large in the panorama of the British Empire. During the war in South Africa, when England had been overwhelmed by a succession of disasters, and when she stood in sore need of friendly help, the colonies spontaneously rushed to her assistance, and, without counting the cost, spent their blood and treasure freely to save the Empire to which they were proud to belong from humiliation and possible ruin. The priceless worth of the services thus rendered by the colonies placed England under an obligation which she must always gratefully remember. The pride of race was then manifested by our kinsmen in its brightest form. They came forward to fight by our side because they had inherited our instincts, our traditions, our literature, tastes, manners, and habits, and because they wished to show on the battlefield that men of English blood, born in far distant lands, had not degenerated from their forefathers The saying of a Canadian statesman, that Paardeberg had made Canada a nation, indicated the spirit which made them send forth their contingents ; perhaps it was still more frankly expressed in a letter from a Highland cousin of mine in Canada, who, writing to tell me that his son had been appointed to a commission in the first Canadian column that went to the front, exclaimed, "Now we will let Englishmen see that we can fight shoulder to shoulder with them against any foe." We may justly feel proud of the feelings of intense respect and affection for the old country which inspired this remarkable uprising of the colonies. These feelings were the fruit of the confidence and liberality with which England had, for at least a century, treated the new nations which were growing up under her wing, and they formed a magnificent tribute to the excellence of our modern colonial system. It must be borne in mind that this spirit of deep-seated and enthusiastic loyalty to the Empire was not called forth first of all by the South African war ; it was displayed with equal energy in the case of the Australian contingent which was sent to the Soudan when Mr. Gladstone was making preparations for a war against Russia, and when it appeared possible that the security of our high road to India and Australia might be threatened. The causes of colonial co-operation were permanent, and independent of political parties or individual statesmen.

The Changes Effected by the South African War.

"A stricken field," as Lord Salisbury said, changes the face of the world, and we need not be surprised that new ideas took possession of men's minds after new nations had been called into existence by the struggle in South Africa, and that a generous desire was felt by all Englishmen to take advantage of an unequalled opportunity in the history of the Empire to cement into a closer political and administrative union the alliance which had been created by war. This was, indeed, a tempting dream. Why should not the colonies, which had so much in common with us, be associated with England by common institutions and a uniform Imperial policy? It was with this object that colonial conferences were held in London, at which questions of the highest importance to the Empire were discussed. But it soon became apparent that political unity could not be secured by any other bond than the link of loyalty to the Crown. The colonies would not hear of subordinating themselves to an Imperial Council sitting in London ; they refused to merge their forces in an Imperial Army and Navy, and, even as regards the framing of tariffs and the collection of revenue, they each claimed the right to stand aloof, to preserve their own fiscal independence, and, in the memorable saying of Sir Wilfrid Laurier, not even for the sake of the British Empire, to accept laws laid down by the Imperial Parliament. Nor was it reasonable to suppose that the colonies could, consistently with their past history, take any other course. Throughout the whole of the 19th century the dominant note of colonial sentiment was a desire to break away from the supremacy of Downing-street and to found distinct nationalities in the separate parts of the British Empire. The lesson which we learnt by the loss of the New World through our injudicious attempt to tax the American colonies was not lost upon the

English people, and from that time forward, whenever a colony made a strong show of opposition to Imperial decrees, we at once gave way. We clung to the old theory that colonies exist for the benefit of the mother country, but as soon as protests were raised against our practice of dumping down transported convicts in Australia or the Cape we abandoned this method of disposing of our criminals. We offered to the colonies the right to participate in the advantages of our administrative organisation and our Imperial policy of free trade, but, as soon as they showed a preference for going their own way, we gave them the right of self-government and the power to impose tariffs which protected their own manufactures against goods shipped from England. All the territorial rights which we once regarded as the heritage of the English people were freely made over to handfuls of settlers, and concession was carried so far that, after the passing of the Australian Commonwealth Act, the authority of the Imperial Parliament over the colonies ceased to exist, and there was nothing left to the Crown but the right of making treaties with foreign powers, against which the Canadians have recently made an angry protest.

The Difficulties of Colonial Federation.

The sustained and prolonged tendency of all these centrifugal forces could not be overcome by a momentary wave of patriotic sentiment, and the colonial conferences made it clear that, while there existed a general feeling in favour of the conclusion of special arrangements with the mother country, no definite line of policy could be laid down, and the several colonies showed their jealousy, not only of control by the mother country, but even of uniform regulations with one another. The only safe conclusion, therefore, we can come to, on an impartial review of the present situation, is, that commercial treaties or tariffs to make binding a general agreement among the separate States comprising the British Empire are quite beyond our reach. That federation is a good object to aim at will be generally admitted, and inquiry and discussion can only be welcome to all who desire the prosperity of the Empire. There is no reason why the controversy should be of a heated character, and I have always held the opinion that the best tribunal in the world to deal with it is a committee of the House of Commons, which, by the examination of expert witnesses, forms an excellent instrument for ascertaining the truth. The first business of such a committee would be to find out the amount of the colonial trade which we have to deal with. The value of this trade is now immensely exaggerated, because we fail to consider how large a proportion of it consists of English money. For instance, the capital borrowed of late years in London by the self-governing colonies reaches the sum of three hundred millions sterling. This amount is remitted from London, not in coin, but in goods, largely, of course, in the form of railway plant and other material for reproductive works, and the imports of the colonies are thus swollen prodigiously beyond their natural limit by the free importation of the equivalent of English money. The imports into South Africa sprang up with a bound last year, but the increase was due to the lavish expenditure of money advanced by England, and was not paid for by the colonies.

India Left out in the Cold.

In all the discussion which has yet taken place on the subject, India has so far found no place. At public meetings and in the Press, we are in the habit of boasting that the British Empire includes a population of over 400 millions of human beings, and it is singular to reflect that, when Imperial Federation is spoken of, we calmly leave the population of British India, which contributes 250 millions of this vast aggregate, completely out of the question. It is not only in population that India forms a preponderating force within the Empire. In productive capacity, wealth, military strength, and ability to play a leading part in all Imperial operations, India is by far the most valuable possession of the Crown. In spite of the rapid growth of our colonies, it is still true, as an illustrious Frenchman said, that it is our hold upon India which makes England fill so large a space in the eyes of the world. Tried by the test of commerce alone, the total trade of India, Ceylon, and the Straits Settlements, is fully equal to that of all the self-governing colonies taken together. The coasting trade of India alone is worth sixty millions a year, a figure which indicates the great activity of internal trade throughout the Peninsula, and the readiness of a large part of the population to take to a seafaring life. The revenues of India are those of a mighty State, and her public works have been framed on a scale which may fairly be described as colossal.

India's Contributions to Imperial Defence.

But it is in her contributions to Imperial defence that India proudly holds the foremost position. Her navy, though comparatively small, is adequate to perform the police and transport service of the Eastern seas, and to be a useful auxiliary to the Royal Navy in time of war. Her army, consisting of 75,000 Europeans and 150,000 native troops, admirably equipped, and always kept in a state of readiness for war, stands hardly second to that of the United Kingdom, and it is important to observe that this splendid force costs the Indian people every year the sum of sixteen millions sterling. In this expenditure is included a million for pensions paid in India, and no less a sum than £5,600,000 for pensions and regimental charges paid in England. English people are probably not aware that the maintenance in England of the non-effective branches of the Indian Army amounts every year to this great sum.

It is not only within her own borders that the army of India does good service to the Empire. In all parts of the East, from China to the Persian Gulf, Egypt, and Somaliland, the Indian troops are eagerly sought to conduct active operations, and their excellent organisation makes them always available. The Government kept its pledge not to employ them against the Boers, but Indian troops replaced in half-a-dozen stations European battalions, which were thus set free for fighting in South Africa, and it is difficult to overestimate the value of the assistance India rendered to our troops in the supply of transport, commissariat, and ambulance requirements. England has been in the habit, indeed, of counting too easily on India's help. She employed Indian troops in the Soudan at the expense of the Indian people, till some of us, who then sat in the House of Commons, raised a protest against the injustice, and from that day to this England has never moved a sepoy out of India, except at her own cost. A still more serious attack on the Indian revenues was meditated this year, when an attempt was made to levy upon the Indian people half the expenditure of the large European army proposed to be stationed in South Africa; but the indignant remonstrances of the Indian Government, and the newly-awakened susceptibilities of the Indian people, who watch such expenditure more closely than they used to do, fortunately sufficed to foil this injustice. Roughly speaking, it may be said that all the regular military work of the British Empire, beyond the Isthmus of Suez, is undertaken and efficiently carried out by India, which is in these respects the chief, and almost the only, partner of the United Kingdom.

English Industrial Investments and Skilled Labour in India.

I have not yet enumerated, however, the many other Imperial interests which India represents. I would point, in the first place, to the magnificent field for commercial and industrial investments which India offers to us, and to the vast array of civil servants, and, to use the old term, English adventurers, for whom she finds honourable and liberal employment. India may now be said to be the only part of the Empire in which men of English birth are warmly welcomed and are sure of finding profitable engagements. It is no exaggeration to say that no less than a hundred thousand English families are dependent on remittances of money earned in India. I suppose there is hardly a village in the country which you can enter without finding some people whose income is principally derived from India. Of course, the salaries paid to Englishmen resident in India are earned by good work, but where else in the Empire would room be found for the multitude of lawyers, bankers, merchants, professors, tea and coffee planters, railway servants, and men engaged in every industrial calling, who spend to advantage the prime of their life in India, and then come home with a suitable provision for their old age? I should estimate the value of the amount paid by India every year for English skilled labour, and as interest on investments, at not less than from £30,000,000 to £35,000,000. This amount is often but wrongly spoken of as tribute. The word tribute means money paid over as an acknowledgement of supremacy, and not as payment for work done. England takes no tribute from India in this sense, but what other country in the world does so much for the English people?

India's Imperial Policy in Trade.

Another consideration which emphasises the peculiar position India occupies in her relations with England is that she has never broken away from her intimate connection with this country, but has always remained perfectly loyal to the authority of the Imperial Government at Westminster, and has always accepted without a murmur the Imperial policy we chose

to lay down. She has never quarrelled with free trade, or even questioned the excellence of our free commercial system, and where she has imposed duties on English manufactures she has countervailed them by an excise duty on those manufactures of her own which competed with ours. She remains the one market in the world which is perfectly open to us, and is by far the largest buyer Lancashire has for the produce of her looms. She has nothing in common, therefore, with the aims of the self-governing colonies, and any one familiar with the administration of India must have read with amazement letters in the *Times* from well-known members of Parliament who declared without a shadow of authority, and in absolute ignorance of the real state of affairs, that India and the colonies were at one in demanding tariff reform. The trade of India with the colonies is quite insignificant, and no sympathy exists between these two separate branches of the Empire. India belongs to the United Kingdom alone, which has guaranteed to her political equality with the governing race, and allows men born in India to become members of the British Parliament, and to aid in passing laws for the whole Empire. If anything could estrange India from the colonies it would be the narrow-minded and unfair action of the latter in excluding natives of India from competition with the white labour which seeks to maintain a monopoly in Australia and the Cape. The colonies boast of their superior enlightenment, but one would think that the most benighted race of barbarians would hesitate to deny the right of Indian sailors, whose country and commerce we have taken from them, to find employment on board the English mail ships running to colonial ports.

Political Changes in India.

The change which has taken place of late years in the political position of India brings her into much closer union with England. The convulsion of the Indian Mutiny was naturally followed by a period of distrust, in which the native princes were debarred from enrolling any troops of their own, and even the regular troops of the native army were only allowed the use of second-class weapons. We have now entered upon an era in which the native princes are treated with respect and confidence, are encouraged to form contingents in which their own sons hold commissions, and are welcomed and made much of at the Courts of the King and the Viceroy as the sincere and loyal feudatories of the Crown. The result of this reliance on goodwill rather than fear is seen in the eagerness with which the leaders of the people in India now press forward on all occasions to offer their gratuitous services to the Empire. One consequence of this policy of bringing India into line with England for the performance of imperial duties is that it will be found necessary to enlarge the political institutions of India and to admit that country into a larger share of responsibility and authority in the government of the Empire. Lord Curzon, the Viceroy of India, in an important speech he made a few months ago in his legislative council, discussed foreign affairs with a freedom hitherto unknown in India, and pointed out that circumstances had arisen which would call for the participation of India in the struggle for supremacy throughout the Asiatic continent as a military power able to take the initiative against any enemy. The significance of this warning has now been emphasised by the Viceroy's display of activity in the Persian Gulf and in the affairs of Tibet, and it is obvious that a Power which is thus required to show her readiness for any emergency without waiting for orders from England cannot always be kept in a state of political tutelage.

Commercial federation has no immediate interest for India because it already exists. If one were asked what is England's chief title to fame as the central State of a mighty Empire, the reply would be that she has been the pioneer of freedom in all parts of the world. Her fame rests on having secured to all nations under her flag the inestimable boon of perfectly unfettered human intercourse. In India, although the conditions of the problem have not hitherto permitted the institution of self-government in the broadest sense, yet the bounds of public opinion have been steadily enlarged, and the authority of England has been established because she has given the people freedom of religion and education, freedom before the law, freedom of thought, freedom of discussion, and freedom of trade. As regards freedom of trade, no reforms have been more beneficial in our own time than those by which Sir John Strachey swept away a multitude of varying imposts and octroi duties throughout India, equalised the incidence of taxation, and settled the principles of tariff reform on the lines recognised in England as best for the comfort and happiness of the people. We are told that all this is now to be changed, but I doubt if a

change from the state of commercial security and exemption from vexatious duties which India now enjoys will be accepted as desirable by the people of that country.

Preferential Duties.

Some attempts have been made in various quarters to suggest a scheme of preferential duties which would be beneficial to India, but no proposals of the kind that I have seen deserve the attention of reasonable men. I can understand that the Indians would hail with delight the abolition of the excise duties levied on native cloth and yarn, but we know that such a boon to India would never be granted by the British House of Commons. Nor is it easy to see what return India could make for such a concession. A good many ardent Indian patriots, however, excited by the new movement in England, are already claiming that they are entitled to such a boon, But I should like to see the most perfervid advocate of preferential duties within the Empire go down to Oldham, and propose to those constituents of Mr. Winston Churchill, who are threatening to vote against that hon. member because he is a Free Trader, that the Excise duties on Indian goods should be repealed, while the Customs duties on English manufactures are retained. Yet such a concession would be the logical consequence of the tariff reform which now finds so much favour in England. All the preferential privileges asked for appear to be on one side. We are told that it would be a good thing for India to have the great English market reserved for her wheat also, when a similar monopoly is granted to the Colonies. But Indian wheat forms only a small fraction of the great imports of grain required to feed the English people, and there is no room for much expansion, as there is not in India an unlimited area of uncultivated land which might be devoted to the cultivation of this particular crop, such as exists in Canada and the United States.

Indian Tea and Cotton.

Then we are asked to direct our attention to tea, and to think how much India would gain if she were secured against all competition of foreign tea in the splendid open market of England. But people who talk in this way do not reflect that the trade of the British Empire is carried on with the whole world, and not with only a few favoured countries. What would be the result, the inevitable result, of penalising tea from China in favour of its Indian competitor? British trade with China is nearly as valuable as with India, and we have lately taken infinite pains to conclude a favourable commercial treaty with the former country. It is clear that China will not be disposed to take the exclusion of her tea from the English market, "lying down," and that she could easily retaliate upon India for the suggested preferential duty in favour of Indian tea. An edict from Pekin is all that is required to prohibit the importation of Indian opium into China, and it is unlikely that England would make such a prohibition the pretext for another opium war. I have also read of proposals made in high quarters in India to place a countervailing duty on Russian petroleum oil, which is greedily bought by the natives, and has completely superseded the familar old cocoa-nut oil butties. I should have thought that the ludicrous results of the imposition of countervailing duties on sugar would have sickened the Indian Government of this kind of legislation. But, here again, I may point out that Russia has an instrument ready at hand, by means of which she could punish India for attempting to injure her. There is now a considerable trade in tea, from Colombo and Bombay, which is carried through the Suez Canal and the Mediterranean to Batoum on the Black Sea, whence it is conveyed by Russian railways into Khorassan and Central Asia. Russia could stop this trade at once if her oil is penalised, more particularly as she has now by means of the Siberian railway broken into China on her inland frontier, become independent of maritime communications, and will soon inaugurate an overland traffic in Chinese tea to supply the greater part of Asia and all Eastern Europe. The duty on the importation of Indian tea into Russian territory has already been increased, but this is only a counterblast to the high-handed action of England in boycotting Russian sugar by the Brussels Sugar Convention. Russia wishes to give us a gentle hint that, if it comes to a question of retaliation, two can play at that game.

But what need is there for any Government subsidy in aid of Indian tea? We all know the amazing progress made by this perfectly new industry within the lifetime of the present generation. A trade valued at £6,000,000 a year has been created absolutely out of nothing by private enterprise, and we have seen the coffee plantations for which Ceylon once was

famous destroyed by disease, and supplemented by tea of such excellent quality that it has taken a leading place in our market, all without any aid from the Government, or any special duty to coddle it into prosperity. Here I may remark upon the mistake that is commonly made by critics who say that Indian industries do not prosper under English rule. Take the coal trade. When I first went to Bombay, some 40 years ago, every ton of coal consumed in the country was imported by sea from England. Indian coal was discovered and worked, and fought its way into use against English competition. Now all the railways and manufacturing industries of the country use Indian coal, which is so much cheaper than coal sent out from England, though in quality it is much inferior, that the English mail steamers take it on board for the voyage up to Suez, and it would find its way into the Mediterranean but for the tolls charged by the Suez Canal. Take again jute, which has been fostered into a great industry chiefly by the private enterprise of Scotch and English merchants. Railways and irrigation works, though now passing into the hands of Government, owe their prosperity in the first place to the employment of capital raised by private subscription. Indigo has flourished through the skill and energy of European planters. An interesting paper just published shows what a revival has taken place in the silk industry of Bengal. The growth, collection, and careful packing of raw cotton from India have been immensely stimulated by the efforts of agents from Lancashire. We are sometimes assured that England might greatly benefit India by granting a preference in favour of her cotton. But India had her opportunity during the American civil war of showing what she could do to supplant cotton from the United States, and it was conclusively proved that her cotton crop was unsuitable in quantity and quality. You are familiar, no doubt, with the old story of the cotton operative who, in the middle of a prayer for more cotton, broke in with the exclamation, "Yea, O! Lord, but not Surats. Oh! not Surats." Only a small proportion of the Indian cotton exported now comes to England. It is mostly taken by Japan and the Continent of Europe. The cotton factory business, again, which competes with the goods imported from Manchester, and does an enormous trade throughout the whole East, was started by some shrewd Scotchmen resident in Bombay. There is, in fact, hardly a trade or enterprise which the application of English enterprise and skilled labour has not quickened and made profitable, and England may well feel proud that all this progress has been accomplished under the imperial policy of perfect freedom of trade, to which India, in common with the United Kingdom, has always been faithful. Seven-eighths of the British Empire, as we have seen, flourish under this invigorating *régime*, and it is only the remaining one-eighth that desires any change.

India's Disabilities in Land Traffic.

I have said enough to show that, before any change is made in the settled commercial policy of the Empire, India as well as the Colonies ought to be consulted. India requires no place in any new federation, because she is already federated with England by her complete acceptance of the imperial policy of Free Trade. My own idea, though I have no wish to dogmatise in the matter, is, that what we want in India is not the introduction of any kind of restrictive legislation, or the raising once more of barriers to that freedom of intercourse which that country enjoys, but the increase of facilities for the expansion of her trade. One thing has often struck me, that India's opportunities are sadly crippled by the necessity that is supposed to exist for restricting her relations with the rest of the world to maritime communications alone. The peninsula of India is cut off completely from that immense part of the world which cannot be reached by a mail steamer. This state of things is no doubt the result in great measure of her connection with England. Any one who looks at a map will observe that India is "cabined, cribbed, confined" by the Himalayas, which shut her in like a Chinese wall, and make impossible the trade which in old days she carried on with Persia, China, Central Asia, and Mesopotamia, by the great caravan routes which have fallen into desuetude since the devastating storm of Turkish conquest trampled out civilisation in Asia. Under the rule of the successors of Alexander, the arts and industries of India flourished in all Asiatic countries as far as the Mediterranean, and were carried into Europe. The "huge, earth-shaking beasts" with which Pyrrhus tried to frighten the Romans in his campaign in Italy were Indian elephants trained for service in war. But of all this world-wide trade nothing remains to India.

Since I began writing this paper, I have come upon a statement in an Indian journal that the Russians have reduced the duties on imports from Afghanistan by 50 per cent., and have tried to divert to the Trans-Caspian railway that pilgrim trade which since the Mohammedan conquest has been carried from Indian seaports up the Red Sea to Mecca. This has happened because Russia now has her splendid network of trunk railways extending from the heart of Europe to the borders of Afghanistan and Persia, while we sit entrenched below the Himalayas, rojoicing in the pomp and vanity of Empire, and neglecting the opportunities of securing commercial supremacy in Asia which lay ready to our hand. In the same way we have let go our control of the trade of Persia. A distinguished Englishman, who once held a high position at the Court of Persia, told me some years ago that, when our influence overstepped that of Russia at Teheran, the Shah offered to concede to this country the privilege of constructing railways within his dominions, which he has since transferred to Russia. I had an opportunity some time afterwards of mentioning to Lord Salisbury what I had heard, and he hastened to assure me that no such offer had been made by the Shah while he was at the Foreign Office. That, no doubt, was so, but the information conveyed to me was unimpeachable, and I can only suppose that the offer was made in one of those intervals when Lord Salisbury was out of power, and that it is pigeon-holed somewhere in our Foreign Office.

Advantages of International Commerce.

It is in the direction of expansion in Asia that we may look hopefully for the acquisition by India of a wider sphere of commercial influence. Nothing worse can happen for a nation than that it should sit down comfortably within its own borders, and regard with jealousy and dislike what goes on elsewhere. It has become far too much the fashion in England of late to speak of the rapid progress made by some Continental States as an injury done to ourselves instead of hailing it as a contribution to the increased productiveness and wealth of the world. Of course, European States have advanced rapidly of late years, more rapidly, perhaps, than we have. Our progress was of an earlier date than theirs, and it is fifty years since we began to reap the full enjoyment of the industrial and commercial supremacy acquired for us by successful wars, and by the inventive spirit applied in the development of our manufactures and the construction of our railways. Some time ago, the German Kaiser remarked, with his customary frankness, that in all matters of business England was, at least, a hundred years ahead of Germany. Naturally, all Continental nations have been eager to fill up this gap, and have made strenuous efforts to overtake us. They have been aided by a prolonged period of peace, which has lasted now for thirty years, and, in Germany, progress has been still further stimulated by the formation of a mighty Empire out of a multitude of petty States, and the uprising of a spirit of enterprise and adventure which reminds us of the England of Queen Elizabeth. All through the Continent of Europe, natural resources have been developed, and new industries established. Immense strides have been made in the extension of railways, and the creation of greater facilities of rapid communication between different countries. The Alps have been tunnelled in half-a-dozen different directions at enormous cost, and a great inland traffic thus established between Central Europe and Italy. The construction of the Siberian Railway as far as Pekin has more than equalled the stupendous feats of American engineering, and has restored all Asia to active life.

One incidental consequence of this remarkable development of productive and organising ability in the two great continents of the Old World seems till now to have escaped public notice. I venture to point out that an economical and constructional revolution has taken place which has immensely extended, quickened, and made more comprehensive and secure the overland communications and exchange of trade in Asia and Europe, and has thus greatly narrowed the scope and influence of that "sea power" which forms England's peculiar strength, and which was quite overwhelming twenty years ago, when Captain Mahan wrote his famous book. Again, England herself has contributed largely to the successes that our Continental rivals have achieved in industries which were thought to be peculiarly our own. I remember that, when I was Member of Parliament for Oldham, the late Mr. S. R. Platt, the head of the principal firm of builders of cotton factory machines in Lancashire, told me that he himself had fitted up a hundred mills in Russia. Lancashire now, of course, feels the effects of the competition thus created.

"Keen were his pangs, but keener far to feel
He nursed the pinion that impelled the steel."

If we still keep our place as the chief workshop of the world, we owe it to the superior skill of our mechanics and artisans, and to the unrivalled cheapness of their food and of the raw materials of their industry. But it is idle to suppose that we can keep back foreign nations by barring them out of our ports, or by attributing to their tariffs alone advances which are due to far other causes.

The Open Ports of the Empire.

Sir Michael Hicks Beach remarked lately that he had been impressed by the immense importance all foreign nations attached to England's open market. That is the real secret of our supremacy. When our market ceases to be open to all the world, we shall lose everything. It is not only free imports by which we flourish, but by perfect freedom in all things. We have become the carriers of the world because the foreigner knows that he can come to an English port without being vexed by a multitude of embarrassing restrictions. This is the reason why we enjoy a vast transshipment trade in goods sent to this country for redistribution among foreign States, and why London is still the great mart of exchange for the monetary transactions of the whole world.

The Trans-shipment Trade of East and West.

The surprising extent of our trans-shipment trade is not generally known to the British public. This trade in England is worth fourteen millions sterling a year, and the profits we make by it would more than outweigh the amount of a considerable protective tariff on foreign manufactures. It is only the trust which foreign nations place in us which brings all this merchandise here for redistribution. I was amused to read the other day a speech by a member of the Government who loftily declared he did not want England to be an Imperial Carter Paterson. Yet what was Venice in the height of her wealth and fame but a magnified Carter Paterson? It was the command of the world's carrying trade that made her great. This passed from her to Spain and Portugal, and is now our inheritance.

It is not our Empire only which we control. We are the brokers, agents, merchants, shippers, and bankers of all other nations as well; they all pour their money into the lap of England. The Thames is still the chief international causeway, and the high tide of civilisation still flows in front of the Imperial Palace of Westminster. But it is not only in the West that the carrying trade belongs to us. In the East, also, thanks to our possession of India, we enjoy the monopoly of a most valuable trans-shipment trade. The total tonnage entered and cleared at the great seaports subsidiary to India of Colombo, Singapore, and Hong Kong, which we have placed as sentinels of the British Empire at the chief strategical points of the principal ocean highways to guard the freedom of the seas, reaches the enormous aggregate of fifty millions sterling. As the merchandise at these entrepôts is entered twice, both as imports and exports, the value of the goods consigned for redistribution should be reduced by one half to twenty-five millions. This added to England's fourteen millions, brings the grand total for the Empire up to thirty-nine millions.

Conclusion.

It is freedom alone, then, that priceless gift which England has bestowed upon mankind, that makes our strength, and we shall do well not to part with it rashly. Protection has many attractions, but, as a matter of policy, we ought to remember that, if Free Trade is the gospel of enlightened selfishness, Protection is the gospel of unenlightened selfishness. Are we going back to the old days when every British industry was safeguarded by legislation, and when, for instance, our woollen trade was thought to be so much endangered by the importation of the fine cottons of India, that the State required the shrouds of the dead to be made of wool, an edict which inspired Pope's couplet on the dying lady of quality—

"Odious! In woollen! 'twould a saint provoke,
Were the last words that poor Narcissa spoke."

May I conclude with a few words of warning against the too eager adoption by the advocates of Imperial Federation of the discarded legislative methods of a bygone age? The Prime Minister assures us that the plan of letting commercial precede political union always succeeds, and instances the formation of the United Kingdom of Great Britain out of the two kingdoms of England and Scotland. But is it the case that fiscal unity was the first step in the federation of England and Scotland? My own impression is, that differences in the taxation of the two countries lasted till the middle of the 19th century. I can well remember that when, as a small boy, I made my first journey

on that road to England which is said to be taken at some time or other by all good Scotsmen, the coach stopped at Berwick for an examination of passengers' luggage before entering England, and I was deeply impressed with the seizure by the Customs-house officers of a bottle of Scotch whisky, which a poor young man was innocently conveying from Edinburgh to his mother in Newcastle. This incident serves to show that, when you begin to discriminate in tariffs, there is no knowing where you will stop. It often seems to me that there is one example in the history of Europe of an attempt to establish a land-locked and self-sufficing Empire, seeking to be perfectly independent of foreign trade, which ought not to be overlooked. I refer to the overgrown Empire of the great Napoleon, which, when England alone remained unsubdued, "when Austria bent, and Prussia broke, and Europe bowed beneath the yoke," embraced the whole Continent from the Baltic to the Mediterranean. Napoleon then attempted to force England to make peace by destroying her commerce, and he forbade the importation of English goods into any of the Continental seaports. This policy recoiled upon himself. The English Government retaliated with the famous Orders in Council putting the whole of the Continent into a state of blockade; and, although Napoleon did us some damage, he did infinite harm to his own people. Smuggling became the favourite pursuit at every seaport, and was connived at by the whole population. Napoleon's own Marshals made fortunes by winking at the acts of the smugglers. All his Court took to smuggling; his own wife became the chief smuggler in the Empire, and the disastrous conflict went on till it was ended on the day of that battle of giants at Waterloo. Let us then beware of the beginning of tariff wars. Let us be on our guard, not, in pursuit of a vain chimera, to imperil the choicest fruits of human intelligence and human liberty.

DISCUSSION.

The CHAIRMAN said he thought that they might congratulate themselves on the raising of this particular branch of the controversy of fiscal reform, India being one main factor in our imperial fabric. The question which Mr. Maclean had raised as to India's position in an imperial and commercial federation appeared to have gone by the board, unless they might take into account the sporadic efforts made by means of letters to *The Times*, such as the brief but lively passage-at-arms which he had with Sir Charles Elliott in the columns of that paper. In this connection he might also mention Sir Charles Elliott's very useful and suggestive article in *The Empire Review* of this month. The imperial federation of the colonies and the imperial federation of India were two totally different things. They must not overlook the fact that India was governed by the sword, and was, as Mr. Maclean had said, for all practical purposes, already federated with Great Britain. As to commercial federation, he thought that some reasonable "give-and-take" scheme, which would join both India and the colonies to Great Britain, would be perfectly workable. He thought that past history abundantly proved that the most effectual means of obtaining political union was through the Custom-house. And on this point he joined issue with Mr. Maclean. Was it possible to conceive any commercial arrangements under which the whole of our self-governing colonies should come in for substantial boons while India alone was left out in the cold? He did not quite gather from Mr. Maclean whether, assuming that the unofficial proposals for fiscal reform which had been brought forward by a great statesman were accepted by the country, he would still object to India being made to join. At any rate, Mr. Maclean had earned their gratitude for having, so to speak, opened the ball, and whether they agreed with him or not they would all appreciate his real knowledge of the subject, his lucid exposition, and his fair and temperate, if not altogether impartial, handling of it. For nearly a quarter of a century Mr. Maclean had a very large part in moulding public opinion in India, and he undertook the defence of Indian social and commercial interests against the generally immature and sometimes arbitrary action of the Indian authorities. He (the Chairman) believed that the high-handed caprice which used to characterise the executive efforts of Indian bureaucracy had now practically died out. He was particularly glad to mention that point in the presence of an old Secretary of State for India (Sir Henry Fowler), than whom, he sincerely believed, no one did more to bring about that most desirable state of things. Members of Parliament had had occasion to admire Mr. Maclean's independence of character, fearless exposure of abuse, and indifference to local unpopularity. Personally, he (the Chairman) disagreed with Mr. Maclean's conclusions, because he believed that he had arrived at those conclusions by a too close adherence and attention to the statics of the problem, and that he had underrated the dynamic forces which the modern conditions of commercial activity introduced all the world over. Assuming, for the sake of argument, that the unofficial preferential tariff proposals were accepted by the country, they might ask themselves what were the lines along which India should proceed in connection with those tariff proposals, and whether the balance of commercial and economic advantages and dis-

advantages was such that that balance was likely to inure to India's welfare or the reverse. What would happen to India if she did join the Imperial Customs Federation? Probably she would be asked to reduce considerably her duty on those imported goods received from Great Britain and the colonies, and, on the other hand, to raise her import duties on articles received from foreign parts. What did the imports into India consist of? Mainly manufactured and partly manufactured articles, with the exception, he believed, of kerosene and raw silk. India now depended for her revenue to a great extent upon her Customs. He believed that the volume of imported goods would not suffer any great diminution if the import duty was raised to a reasonable extent. But, as to her exports, it might be asked whether the foreign countries to which she sent her products would not retaliate if she raised her duties on imported goods. To answer that question adequately one must consider what the nature of the exports from India was. They consisted of food and raw material, with a single infinitesimal exception, gunny bags, and he thought that foreign nations would hesitate before they took measures of reprisal against India, the direct consequence of which would be that they would raise the cost of the food necessary for their populations, and of indispensable ingredients for the carrying on of their industries. The author referring to wheat grown in India, said that the area of cultivation was practically exhausted; but he (the Chairman) had an impression that in the United Provinces and the Punjab there was something like from 24 millions to 30 millions of acres absolutely lying fallow, and certain to be put under the plough if there was a preferential arrangement under which wheat came into England free. Let them think what an advantage it would be to India if she was encouraged to grow more wheat and grain. It would widen her area of employment, and diffuse her wealth. and an incidental element of the prosperity would be that measures would be taken in order to avert the too frequent recurrence of blight and famine. The author indulged in what he (the Chairman) considered to be a rather undeserved sneer at the action of the Indian Government in connection with sugar. He should have thought that the author's great belief and conviction in favour of free trade would have commended that action to his judgment. What had happened was that the action which had been taken had led to the abolition of bounties upon sugar. Surely, bounties upon sugar were not a thing that could be said to be compatible with the doctrine of free trade. A commission was appointed by the Government to enquire into the matter, so that there could be no question but that the action which had been taken was decided upon after a most thorough, searching, and impartial investigation. The effect of taxing bounty-fed sugar taken into India was that it had very considerably reduced the importation of that kind of sugar, and that had been replaced by sugar coming from countries in which we ourselves were interested—Egypt, Mauritius, and the West Indies. The only other objection which he had heard raised to preferential tariffs was that India would not be able to purchase those cheap and nasty scissors and knives which arrived there in such large quantities from Germany. Why should it be assumed that the enterprising cutlers of Sheffield given a firmer hold on the home market would not be able to produce articles which, though they might cost a few annas more, would be far more durable, and which, in the long run, would be far more cheap? He would sum up his remarks by saying that his own humble view was that a reasonable scheme of preferential arrangement would be distinctly beneficial to India. He believed that the policy of blind and unconscious drift, in deference to an economic ideal, was dead—dead as mutton. He thought also that a hard and hide-bound system of protection would be no better for India than it would be for England. But he would assert that, if foreign nations universally rejected the demand which one day the people of this country would infallibly make for fair treatment, we should have to encounter the evils of protection by a defensive retaliation, or by any process ready to hand, in order to stave off greater evils, namely, the evils of loss of trade and loss of employment. The resources of British civilisation in the adoption of an imperial fiscal policy would be found, he hoped, not to be exhausted. Then India would be able to reap her rightful and legitimate share of the benefits accruing from that system, as one of the partners. She would, he thought, courageously accept her part of the burden, and stand as one of the most flourishing elements in our splendid and indivisible Empire.

The Rt. Hon. Sir HENRY FOWLER, G.C.S.I., M.P., said that he should like to ask where India came in in the present fiscal proposals. India had been left out of all the proposals that had been made. There were two schemes before the country. The Chairman had alluded to the unofficial scheme, and the reader of the paper had dealt with a portion of both schemes. The first scheme which they had to deal with was the official one, which was that of the Prime Minister, and those whom he represented. But how was that scheme going to affect India? He would invite Indian experts to answer that question. He understood the official scheme to be that, when nations imposed upon us harsh, unfair, and unjust tariffs, it should be in the power of the British Government to retaliate upon those nations by tariffs of a penalising character. How would India be affected by such a transaction? Mr. Maclean had pointed out that India was already federated, and was part of the British Empire, as much as Kent or Sussex. He was not aware that anything was "dumped down" in India, and he was not aware that any of the industries of India had been ruined. He was under the impression that the industries of India were, perhaps, more prosperous to-

day than they had been within the memory of man. He would enter a *caveat* against what the Chairman had said with reference to the effect of the sugar legislation in India. He was under the impression that there was more sugar imported now into India from the bounty-giving countries than there was before the legislation took place. But he wanted to know what was the industry in India which would be benefited by retaliatory duties. The bulk of the manufactures of India consisted of articles on which no or small tariffs were levied in the countries to which they went. What had India to gain by causing a war of tariffs which would inevitably result in those products which India sold being penalised in the country to which she was now sending them virtually free at the present time? Again, if there were retaliatory duties, two sides would play at them. The United States now imported a large number of commodities from India and admitted them at a low tariff. If retaliation was commenced by this country against the United States the United States would retaliate on the whole of the British Empire. Well, India would gain nothing by that. But what was to be her position with reference to her own tariffs? He agreed absolutely with Mr. Maclean that it would be a very disastrous thing if Sir John Strachey's policy was finally abandoned. It was altered for a time because owing to the fall in the value of the rupee India was in a great monetary crisis, and was obliged to impose duties. As to the cotton duties, they could not allow India to relieve herself from the excise duties which we levied upon cotton. Where was the preference? Were they going to impose duties upon cotton goods from England? If so, he thought that there would be a great deal to say in Lancashire upon that question, and also in India, because at the present time the overwhelming bulk of the imports into India consisted of the cotton goods of Lancashire. Therefore a great difficulty would be created there. They did not really know what the proposed plan was. Nobody had told them how the official programme of retaliation was to be carried out. With our complicated commerce, how could the retaliatory duties be inflicted? Assuming that they were levied, he thought that they would be injurious to India. But let them take the unofficial programme, which was more like business, for that was a proposal which he thought they would come to very soon. What was that? It was that there was to be a preference granted to food coming into the United Kingdom. There was to be, in addition, an import duty levied upon all manufactured or partly-manufactured goods coming into this country. How did that affect India? That was what he asked the experts to say. India had no disadvantage at present in her export of wheat. The risk of the Indian market was the uncertainty of the crop. He believed that there was an enormous future for India in the cultivation of wheat and the export of it, but a great deal had to be done before that could be carried out, and especially in the way of bringing more wheat-land into cultivation. But what about manufactured articles? It meant that everything that India bought now was to have a duty levied upon it. Therefore, they would be confronted with the cotton question. At present India, for revenue purposes, raised a duty of something like five per cent. That would have to be turned into ten per cent. But why should India be further taxed? The Indian people would have to pay the tax. If this scheme was carried out, they would have to increase the Customs duty in India by five per cent., and the Indian people would have to pay. Where was their compensation for doing that? The unity of the Empire was very well in its way, but he did not think that that was an argument which they could very well apply to the Indian peasant. His complaint was, that India had been forgotten. Three out of four of the living ex-Viceroys of India were antagonistic, in the interests of India, to the proposed fiscal policy. He believed that all the living preceding Secretaries of State for India were also opposed to the policy, and certainly one of the ablest speeches that had been delivered in the whole of this fiscal controversy, was delivered by Lord George Hamilton, who approached the question from the Indian point of view, and, as Secretary of State for India, refused to be a party to the proposed changes, whether they were official or unofficial.

Sir Edgar Vincent, K.C.M.G., M.P., said that the Chairman had remarked with great truth that in this discussion India had gone by the board. He would suggest that, if Mr. Maclean reprinted his admirable paper, he might take as a second title for it "The Strange Case of Cinderella," because, while all the self-governing colonies had been invited to this preferential feast, India had been left out. He thought that all present would be agreed that, if the Government gave preferential treatment to Australia and to Canada, it could not do otherwise than give it to India. He would add that the preferential conditions given to Indian trade must not be less favourable than those which were given to Canada and Australia. Canada and Australia levied protective duties upon English goods, but they were to receive preferential treatment. India and South Africa did not levy protective duties on English goods. Therefore, in fairness, they were entitled to superior treatment. How would the unauthorised policy work out in the case of India? England would have to give India preferential treatment, but that would be found very difficult. In order to give it to Indian cotton, England would have to put a duty on American cotton. But would this country stand an import duty upon one of her staple industries? Again, could a duty be put upon jute other than Indian, in order to give Indian jute a preference? Or could the duty on China tea be increased, in order that the duty on Indian might be reduced? In such an event would not the Chancellor of the Exchequer be placed in a revenue difficulty? India would be able to claim to act towards English manufactures in the same way a

Canada and Australia did. What was the first thing for which India would demand protection? Clearly cotton. Therefore, the excise duty would have to be taken off the Indian production of cotton, and they would have to treat the English importation of cotton piece-goods, and yarns, in such a manner as to give the Indian producers an advantage over Lancashire. India was by far the largest purchaser of the cotton productions of Lancashire. She took 40 per cent. of the cotton piece-goods and 20 per cent. of the cotton yarns. If the Indian trade was destroyed, what would become of Lancashire? There would be more unemployed in that district than there were now in the whole country. But it would never come to that, for he absolutely declined to believe that when the voters of Lancashire saw the risk of preferential treatment in favour of Indian cotton mills, they would accept the policy for a single instant. Let those who favoured the proposals come forward with a precise scheme. He wanted to see a closely-reasoned argument, showing precisely how the tariff reformers proposed to deal with this apparently insuperable difficulty. A great many people were inclined to support the new policy on the ground that it would be a step towards absolute free trade within the British Empire. But it was, in fact, a step in an absolutely opposite direction. The present obstacle to free trade was the protective wall of Canada and Australia; and by the action which was taken in agreeing to the maintenance of that wall England not only perpetuated and strengthened its establishment in the colonies where it existed, but directly promoted the establishment of protective tariffs in colonies which now had free trade. That was called a step towards a general English Zollverein. No policy which was adopted by this country should be based upon a partial or sectional diagnosis, Let the whole matter be viewed in its entirety. Otherwise we might be landed in a policy of which the immediate effect in one direction might be good, but of which the ultimate effect, upon a larger scale, would be disastrous. A policy adopted without a full discussion of its bearings upon every single unit of the British Empire would lead to action which was not in harmony either with economic and commercial advantage or with political wisdom.

Sir CHARLES ELLIOTT, K.C.S.I., said that he addressed the audience with some diffidence, because Mr. Maclean had written in his paper that no proposals made on this subject, that he had seen, deserved the attention of reasonable men—so that he stood condemned already as devoid of reason. But he thought Mr. Maclean, with his long experience, ought to know that the first duty of a controversialist was to understand the views he opposed, and the failure to do that was often due to not having given them due attention and consideration. This apparently was Mr. Maclean's case, for his paper showed that he was equally at sea as to the facts of the case, and as to the principles of his opponents. He thought that Mr. Maclean had altogether missed the line of argument which would be followed by those who were in favour of the treatment of India according to the proposed policy. The principle of the unofficial programme would be to examine every article of mutual commerce and see how an alteration of the tariffs would benefit either country. There were certain articles as to which an alteration of the tariff would seemingly do good both to India and to England. Mr. Maclean stated that England had already a commercial federation with India, but he denied there was anything of the kind. That country was treated with the most absolute indifference. Sir Henry Fowler had spoken with great justice of the admirable policy of absolute free trade introduced by Sir John Strachey twenty years ago; but there was no reciprocity on the part of England. England never thought of taking off the duty on tea and coffee because India had taken off the duty on all imports from this country. Each country acted independently of the other. Then, again, whenever he dealt with facts, Mr. Maclean was inaccurate. For instance, with regard to tea, Mr. Maclean had said that if the duty on Indian tea was reduced, and that on China tea kept up, China would turn round and stop the Indian opium. But the value of tea imports from China was now only about half a million, against eight millions from India and Ceylon. Would the loss of so small a quantity of trade agitate China much? Even if it did, Mr. Maclean knew that China had tried its level best to stop the opium trade and had absolutely failed to do so. Again, he said, there was a considerable trade with Russia in tea, and that Russia could stop this trade at once if her oil was penalised. But Russia had always done her utmost to stop the importation of Indian trade. Mr. Maclean could hardly have forgotten how, about 25 years ago, there suddenly sprang up a great trade in green tea through Afghanistan into Central Asia. All the planters in Kangra, Dehra Dun, and Kumaun thought the millennium had come, and turned their whole attention to making green tea, and for a couple of years they made great profits. Then Russia stepped in, imposed a heavy duty, and utterly crushed the trade. As to the "considerable traffic by sea to Batoum," probably Mr. Maclean did not know that this traffic had amounted to £200,000 in 1897, but had fallen to £35,000 in 1901-2. And it is for fear of the stoppage of this insignificant trade that he warns us against irritating Russia! This is a typical instance of the arguments of the old school. They are always saying, Don't strike back, or the other country will kick you harder. They won't understand that the other countries are kicking us as hard as they can, without hurting themselves, already; and that the result of our striking back will be that they will kick us less hard, not harder. Similarly, with regard to wheat, he agreed entirely with the Chairman that Mr. Maclean had missed the real point. There was

a vast area in the Punjab which would come under irrigation when the schemes of the Irrigation Commission were carried out, and which could produce wheat, and that wheat would be almost safe from drought. The supply would be uncertain, and England could not rely on it, but it would be an enormous benefit to India to have that wheat as a reserve to fall back on in case of famine. It had been said, that if we taxed Russia's petroleum, Russia would pay us out somehow. But Russia was already paying us out to the best of its power. It taxed our exports 50 per cent., and we taxed nothing in return. If England had the £2,000,000 worth of petroleum to deal with, England would have an implement against Russia, which it had not now. He held that India had nothing whatever to do with retaliation, and the principle would not apply there, because no country is taxing Indian exports like they are taxing ours. He did not agree with Sir Edgar Vincent, that every country must be treated in reference to other countries. The whole system would, he believed, be simply one of bargaining, and each case would be treated on its own merits. There was a great deal that England could give India, and that India could give England. He entirely repudiated the doctrine that the arrangements which were being talked of now with regard to favouring the colonies would affect our relation to India. No claim to a new system of protection could arise in India. No doubt a good deal of protection would have been popular in India long ago, but it was marvellous that the cotton mills had so grown up without protection. There was an enormous wealth of minerals in India, but they made no steel or iron there. Those things would grow up much more quickly in India under protection, but the history of the cotton and jute mills showed that they could grow without it. He abandoned the suggestion he had made in the correspondence in *The Times* with the Chairman that the cotton duty in India could be removed and the countervailing excise duty kept up. He believed that from a revenue point of view it would be quite practicable to abolish both. He believed that the policy of the unofficial programme if carried out would be highly beneficial to India. Arrangements between India and England as to preferential rates might be beneficial to both countries.

Mr. MACLEAN, in reply, said that they had had a purely protectionist speech from Sir Charles Elliott, but he really did not know what line Sir Charles proposed to take. Did he or did he not propose to do away with the Indian duties on the manufactures of Lancashire? If that was his scheme what would he substitute for the revenue which the Indian Government now made upon cotton goods? Sir Charles Elliott had told the meeting that it would be a very good thing for India to put a tax on Russian petroleum oil. But would that be for the benefit of the Indian people? The people bought the Russian petroleum in preference to their own cocoa-nut oil, on account of its cheapness, and Sir Charles Elliott would benefit the people by putting a duty upon it. That was a very good sample of the arguments in favour of protection. Sir Charles Elliott said that we were going to let India severely alone, though making arrangements with the rest of the Empire. That would be indeed treating her as the Cinderella of the Empire.

Sir CHARLES ELLIOTT said that what he said was not that India should be left alone, but that the arrangements made with India would be made separately and apart from the arrangements made with the colonies.

On the motion of the CHAIRMAN, a hearty vote of thanks was accorded to Mr. Maclean for his paper.

Sir FREDERICK YOUNG writes:—As I had not an opportunity of taking part in the discussion of the paper which was read by Mr. J. M. Maclean before the Indian Section of the Society of Arts, I crave your indulgence to make one or two comments upon it. The title of the paper on the invitation card, as sent to me, was as follows:—"India's Place in an Imperial Federation." As one who, for so many years, has taken a prominent part in advocating the principle of this great national question, I attended the meeting under the impression that it would be treated by the author on the basis of the formula, advocated by its supporters, of the kind of representation which would be given to India, as forming so important a part of it, in an Imperial Senate, or Parliament, or Council of the Empire. I was, of course, surprised to find that this initial important ingredient of the political scheme which is recognised by the term Imperial Federation was not the real subject of the paper. It was, instead, an essay on the aspects of the present and the proposed fiscal policy as affecting the Indian Empire. From the author's very pronounced views on the subject, the paper was an interesting and able one. While disagreeing with many of his points, I listened to it with much pleasure. As one who has studied the subject of Imperial Federation, and given expression to my opinions upon it for many years past, I feel bound, however, to enter my protest against the title given by Mr. Maclean to his paper, which was most misleading and incorrect. I confess I anticipated that, considering the title of it, he would have propounded his views on the question of the representation of India on the proposed Imperial Assembly, and not on the aspects of the fiscal policy at present agitating the nation, on this occasion. On the actual paper itself, there was evidently a wide difference of opinion among the speakers who discussed it. Had I done so myself, I should certainly

have joined in differing from many of the points which the author urged would follow, most injuriously to India, from the adoption of any change in the present fiscal policy, and the substitution of a preferential tariff for every portion of the trade, India included, of the British Empire.

Sir RICHARD TEMPLE writes :—Time did not permit me to make the only observation I have upon Mr. Maclean's remarks. The whole discussion strikes me, from a practical point of view, to be premature. India, under a Government subordinate to Parliament, depends entirely upon Parliament for its Imperial policy. The Imperial policy of Parliament from time to time is the outcome of the elections, and, in my judgment, we may take it for granted that, at the elections, India will not be considered. Therefore, it is the result of the situation that the position of India is not of itself considered in such questions as free trade, protection, preferential tariffs, and retaliation, when these are before Parliament as matters of Imperial policy. The only practical question, then, that Indian statesmen and thinkers have to consider is, how to meet and act under the conditions resulting from any particular decision of Parliament in such matters as these. It is true that the effect on India of a general proposed policy may be considered in the preliminary discussions thereon, but such consideration must perforce be academical until the proposals take a definite turn. There is nothing before the Indian Government and the Indian people to practically consider until some concrete point of detail is actually before Parliament for decision. It may be taken for granted that any such point in such a question as fiscal reform will be before Parliament for a long while, and there will be plenty of time to make representations to Parliament if a proposal involved in it is likely to operate adversely to India. To consider the position of India as matters stand now is very like crying out before you are hurt, for no one knows at present exactly what is going to be done.

Sir WILLIAM WEDDERBURN writes : — In the debate which followed Mr. Maclean's paper on "Imperial Federation" all the speakers were agreed on one point, viz., the injustice and absurdity of leaving India out of consideration in any wide scheme of fiscal change. How will the authorised and the unauthorised programmes affect India ? And what are the feelings and wishes of the Indian people regarding them ? It is certainly important that we should know, but unfortunately there exists no official machinery for obtaining, at first hand, a representative opinion on these points. The Secretary of State for India might, under the existing law, appoint one or more representative Indians upon his Council, but he has never done so, although a recommendation to that effect was made in the minority report of the Royal Commission on Indian Expenditure. The same report advised that there should always be an Indian member on the Viceroy's executive council, but this recommendation also has not been adopted ; and the consequence is, that the Indian Government, both at Westminster and Calcutta, are out of touch with Indian opinion, and at a serious disadvantage in dealing with questions affecting the economic and social welfare of the people. There remains the unofficial organisation of the Indian National Congress, which will shortly meet at Madras. If the Government would be pleased to ask the views of this representative body, such a reference would elicit a valuable expression of independent public opinion drawn from all the provinces of India.

FIFTH ORDINARY MEETING.

Wednesday, December 16, 1903 ; SIR ROBERT GIFFEN, K.C.B., LL.D., F.R.S., Member of the Council, in the chair.

The following candidates were proposed for election as members of the Society :—

Barzano, Carlo, 6, S. Andrea, Milan, Italy.
Read, William, A.I.N.A., Camber Slip, Portsmouth.
White, Samuel, Dorset-house, Clifton, Bristol.

The following candidates were balloted for and duly elected members of the Society :—

Acker, Charles E., Acker Process Company, Niagara Falls, New York, U.S.A.
Baldwin, Harold O., 3, Blurton-road, Fenton, Staffordshire.
Furse, Captain A. D., F.R.G.S., Glenwood, Chelverton-road, Putney, S.W.
Gauntlett, Paul E., 6, Rood-lane, E.C.
Green, George, J.P., Methven, Balshagray-avenue, Partick, Glasgow.
Ham, Frederic George Sison, A.M.I.Mech.E., 13, Grosvenor-road, Westminster, S.W.
Hills, David, Rosetta, Brackley-road, Beckenham, and 2, Bayer-street, Golden-lane, E.C.
O'Neill, James Joseph, M.I.N.A., 19, Roxburgh-street, Hillhead, Glasgow.
Wall, Frank, Globe Works, Grays, Essex.
Williams, Alfred, 13, Hillcroft-crescent, Ealing, W.

The paper read was—

THE SCIENCE OF TAXATION AND BUSINESS.

By SIR WILLIAM PREECE, K.C.B., F.R.S.

In the address which I had the honour to deliver to the Society as Chairman of the Council on November 21st, 1902, I dealt with the causes which result in successful or disastrous financial undertakings, and I endeavoured to show that there was a true science in

business. By science I mean not only the systematised and organised conclusions of common sense, but the careful sifting and comparison of facts, and of the lessons of experience and observation. Laws have to be deduced from these facts and experiments, and when these laws are confirmed by verification and anticipated by prediction then it can be said that we have established a science.

Science is a term commonly applied to the discovery, development, and narration of the laws of nature, but here I use it to indicate the laws developed by the ordinary events of man's life, collected in numbers as a nation, to render living healthy, comfortable, lucrative, and secure. It, therefore, considers property, commerce, defence and government.

The science of business is based on statistics which when tabulated and graphically recorded as curves or charts indicate facts from which laws can be deduced. In my address of last year I dealt in this manner with the special industries of water, gas, railways, and telegraphs. I purpose now to deal with the business of government, but only with that part of it which deals with the provision of ways and means, which embraces what is called our fiscal system, and which is unfolded to the public every spring by the Chancellor of the Exchequer in the annual balance-sheet submitted to Parliament, known as the Budget.

The chief aim of the ordinary business man is to raise an income to meet his just wants, but we all have a hankering after something else and that is the accumulation of wealth. The business manager of a great Empire has the same prime object before him without the additional incentive of creating a fortune and securing worldly luxury and retired ease by pursuing profession, commerce, industry, literature, or speculation. On the contrary his object is to reduce by every means in his power the incidence of taxation upon his masters—the public.

We have to deal with facts, and these facts must be exact and reliable. If any doubt is entertained as to their truth they must be discarded for verification, and no deduction is permissible on questionable facts. There are facts which are historical and facts which are statistical. The former I will confine to the period embraced by my own life, the latter to the elaborate returns that have been collected and published recently by the Board of Trade.

The returns are :—"Report on Wholesale and Retail Prices in the United Kingdom in 1902," issued August 6th, 1903: "Memoranda, Statistical Tables and Charts bearing on British and Foreign Trade and Industrial Conditions," issued on August 20th, 1903: *The Board of Trade Journal*, which is issued monthly. These returns are authoritative and unquestionable. The deductions from these facts may be disputable.

The business of Government is purely a commercial matter. It should be outside polemical politics. It is a question of £ s. d., and ought to be entirely free from party bias and platform acrimony. I am not a politician myself. I spent thirty years in the Government service, and not one of my political chiefs could say that I belonged to one party or the other. I purpose therefore to endeavour to consider this question from a neutral point of view.

The neutral citizen has this immense advantage, that he is able to read dispassionately each side of a question, and to deduce from rival statements his own conclusions. He is sure to learn all that can be said in favour of a certain proposition, and all that can be said against it. The leaders on both sides summarise the pros and cons. The Press, as a rule, is very impartial in its publication of speeches, both in and out of Parliament. Thus every one can form his own opinion. It is quite certain that if the business principles involved comply with the scientific requirements of truth they will appeal favourably to the average intelligence of the country, and that will ensure their ultimate acceptance whichever party is in power. The fiscal system of the country appeals not only to the patriotism of every Briton, but to his reason and his business acumen. It is either right, or it is wrong. If right it will be maintained, if wrong it will be reformed. How far does it comply with the scientific principles of business?

Definitions.

Commodities imported into this country or exported from it are classified as :—

1. Raw material.
2. Food.
3. Partly manufactured articles.
4. Wholly manufactured articles.

These may be imported or exported *Free* or *Taxed*. They may be taxed for—

1. Revenue.
2. Protection.
3. Prohibition.

Protection is the imposition of a tax not for the purpose of obtaining revenue solely but for restricting unfair foreign competition, for maintaining the activity of home manufactures and industries, and for defensive purposes.

Prohibition means the incidence of a tax so high as to exclude goods entirely from home markets.

The principles that determine the various incidences of taxation form the *Fiscal Policy* of the country.

This policy may be—

1. Free Trade.
2. Restricted Trade.

Free Trade, the child of Adam Smith (1776) is a term very generally but improperly applied to free importation only, but it is more correctly applied to the free interchange of imported or exported commodities between different countries. It was in the former sense that it was used by Peel in 1842, and in the latter sense by Pitt in 1787, and by Cobden and his followers in 1846. It has never been adopted in the latter sense by any country, not even by the United Kingdom. It is, however, in existence between the various constituent States of the United States of America, and between the various units of the Empire of Germany. The policy adopted by the United Kingdom is that of free imports and these only partially applied.

The amount of taxation imposed upon different commodities is called a *tariff*, and this tariff is *preferential* when it is relaxed in favour of any particular country. Peel recognised preference with our colonies in 1842. It was abolished in 1846.

Historical Facts.

Sir Robert Peel was the greatest Finance Minister that ever handled the fiscal system of this country.* He was Prime Minister in the year I was born, 1834, but he was in office for only a few months. The political parties were then called *Whigs* and *Tories*. Peel led the Tories who were beginning to assume the title of Conservatives. He came into office again as Premier in 1841 and remained in power until 1846. The great excitement of the period was the Corn Laws. There was great depression of trade and much distress and even riot in the country. The potato disease appeared in Ireland with its terrible accompaniment—famine. The agriculturist was the dominant power—protected by prohibitive taxation. The manufacturer was beginning to assert himself. Steam and the steam engine multiplied the means of production. Railways expedited and economised transport. Raw materials and coal were more abundant and cheapened. The Penny Post faciliated correspondence and intercourse between supplier and consumer. The Bank system was placed on a permanent and unassailable position. The Telegraph was introduced in 1837 and became later a greater innovator in the transactions of commerce than even Rowland Hill's mails. The mode of conducting business was revolutionised. The battle was between agriculture and manufacture, and Peel, the son of a great and successful manufacturer, who had amassed immense wealth by the loom, decided the contest against the former. The Corn Laws were repealed in 1846.

The command of the sea acquired in the great Napoleonic wars, and the sailor instincts of the nation placed the carrying trade of the world in British hands. The introduction of the screw propeller, and the marvellous improvements in the production of iron and steel have, since Peel's day, revolutionised the construction of ships—their size is immense, their speed prodigious. Watt, Arkwright, Stephenson, Faraday, Whitworth, Armstrong, and Bessemer were pioneers of our marvellous industrial productions, of the great trade of this country, and of its immense wealth. Bessemer reduced the cost of the production of steel from £50 a ton to £5! Gigantic steamers and high speeds have reduced the cost of freight of corn across the Atlantic from 7s. per quarter in 1873, to 10d. in 1901. What has the politician done compared with this in economical policy? The abolition of the Corn Laws in 1846 did not affect the price of bread. The price of corn was in 1842, 73s. per quarter, but in 1846 it was 54s. 8d., and in 1873, 58s. 8d.! It is now 25s. 10d. It is thus clear that the great reduction in price in this principal article of food has very little to do with fiscal policy, but everything to do with scientific application, inventive genius, and engineering skill. Prices are determined by the vicissitudes of trade and by the markets of the world, and not by legislation.

These great engineering operations, and not mere fiscal changes, have revolutionised the

* Although I have read the debates of 1842 and 1846 it is to the admirable study on "Peel" in "English Men of Letters," by Thursfield, that I am indebted for much that I say about that great statesman.

ways of business. Capital with its brains and labour with its craft must always run hand in hand. Wealth can be created only by an expenditure of each, and it is quite a recognised fact that in industry labour imparts one-half the value of the whole. Capital and its rapid circulation is the chief source of wealth. Whereas, in days of old, it took two or three years for a manufacturer to turn over his capital, now it is done two and three times in the year. This means a considerable modification in prices to the consumer and profits to the producer. If an annual turnover means a profit of 10 per cent. to the manufacturer, a fourfold turnover means the same result with a profit of 2½ per cent. on each transaction, the employment of more workpeople, and greater benefits to the consumer. This is the secret of the great success of our "Stores" systems, so prominent in London. The poor Irishman who turns out his landlord forgets that he extinguishes the central force which throws money into circulation. The shopkeeper who ignores the advantage of advertising neglects a force of attraction that brings more customers to his counter, and hastens the turnover of his capital. The town that neglects to support a local industry drives away a source of supply and demand which adds materially to the wealth-earning powers of the residents of the place. One hundred labourers removed means 500 mouths no longer to feed and house.

The true secret of success in business is the formation and wide extension of markets. "Any fool can make chocolate," said Menier, "but it takes a clever man to make a market for his chocolate." Given several countries with equal capital available, that country which gives the greatest facilities for the circulation of its capital becomes rapidly the richest and employs the greatest number. That has been the case with the United Kingdom with its insular position, its command of the sea, its great shipping, its cheap post and its cable system, its banking system, and not, as the politician believes, the adoption of the free trade policy of Cobden. We have acquired our commercial supremacy by our roving instincts, by the energy and enterprise of our merchants, by the inventive skill of our engineers, and by our love of freedom and of civil and religious liberty. If we lose it will be by the blindness of our politicians, by the ignorance of the democracy, and by the closing of our markets.

Free Trade.

Peel had the insight to foresee the growth of manufactures, and he adapted his fiscal policy to meet its rising wants. He was confronted not only by the objectional corn laws, but by a succession of serious deficits. In fact, in 1842, he had to provide for a total deficit of £10,072,000. The Queen's Speech of 1842 said: "I recommend to your consideration the state of the laws which affect the import of corn, and of other articles the produce of foreign countries." The Whigs fought for a fixed duty on corn of 8s. per quarter, but Peel proposed a modified sliding scale, making the duty vary with the price, giving a preferential rate to the Colonies. His view was to maintain the corn laws in principle on grounds of public welfare, so that the country should not be dependent upon foreign resources for its supply of food. In 1849 the tax fell to a fixed duty of 1s. per quarter, which was removed by Gladstone in 1869, but reimposed in 1902, and now again abandoned.

Peel was unquestionably a free trader in principle. His budget of 1842 showed this. He said, "I believe that on the general principle of free trade there is now no great difference of opinion, and that all agree in the general rule that we should purchase in the cheapest market and sell in the dearest." (May 5th, 1842).

Peel came to the conclusion that no fresh increase of duty could succeed, for he found that the limit of taxation on articles of consumption had been reached, and that the home markets were seriously affected by excessive duties. The Whigs in 1840 added 5 per cent. to the existing customs and excise duties, and estimated a return of £1,895,000, but only £206,000 was obtained. Peel adopted the reverse policy. He hoped to restore the revenue by relieving taxation. His principles were:—

1. To remove all prohibition and relax all duties of a prohibitory character to a moderate protective scale.
2. To reduce duties on raw materials imported for manufactures to 5 per cent., making some merely nominal for statistical rather than for revenue purposes.
3. Duties on imported articles partly manufactured not to exceed 12 per cent.
4. Duties on imported articles wholly manufactured, 20 per cent.

His object was to increase the importation of foreign produce by reducing their price to

the consumer and to "make this country a cheap country for living, and thus induce parties to remain and settle here." This carried to its logical conclusion means the total repeal of taxes on food, but Peel clearly saw that it was quite legitimate to impose light duties on foods which do not affect the market nor increase the cost to the consumer. All duties on raw materials except timber and tallow were removed in 1846.

Peel felt that domestic agriculture ought to be protected as an expediency, and in the physical interests of the nation he was undoubtedly right, but in the interests of the working classes he was equally right in doing everything he could to reduce the cost of living of a class then in dire distress. However, bad harvests, famine in Ireland, the powerful reasoning of Cobden and Bright, the inexorable logic of facts, pure patriotism and a noble nature induced him to waive all ties of party. He boldly accepted the principle of free trade in corn, and he carried out the relaxation of the Corn Laws so as gradually to reduce them to a mere nominal point. Peel changed his opinions with his experience. He was accused by his political opponents of being paradoxical, inconsistent, and contradictory. Is it not well that our statesmen should have open minds? Is it not well that they should be willing to be taught? We live in times of great topsey-turveydom, and political circumstances are as changeable as weathercocks in variant breezes. All honour to the faithful servant of the State who, when the public welfare demands it, and convincing facts confirm it, rejects all party ties, throws up political power, eschews all emolument, and reverses political prepossessions in obedience to the dictates of conscience.

It is interesting to compare the Revenue of 1842 with that of 1903:—

Financial Year.	1842.	1903.
	£	£
Income Tax, Land and House Duty	5,128,895	33,100,000
Customs	23,056,272	34,640,000
Excise	13,919,454	32,700,000
Estate Duties	Nil.	13,300,000
Stamps	7,350,457	8,400,000
Post Office	1,893,702	19,100,000
Crown Lands	445,594	445,000
Miscellaneous	589,623	2,585,000
Total Revenue	52,584,000	144,270,000

The population in 1842, 25,000,000; in 1903, 42,000,000.

The Customs and Excise now far exceed the total income of 1842, and in spite of the great reduction of taxation and the introduction of free imports of food and raw materials, Customs still give us £34,000,000!

The great growth of the Post Office is remarkable.

The income per head from all sources was in 1842 £2·13; in 1903, £3·43.

It must not be forgotten that the British Government has no capital account, and what is usually charged to capital in commercial and industrial business is in Imperial business charged against revenue.

The Currency.

The Bank of England had abandoned cash payments in 1797. They were not restored until 1819 through the action of Peel, which was his first great financial achievement. Our present banking system was settled by Peel in 1844, when he passed the Bank Charter Act. It established a uniform single metallic standard (gold) for the national currency, and determined the power to issue notes by the condition that the Bank must keep in store sufficient bullion to enable it to pay over the counter in coin any notes submitted. The Mint is required to coin its sovereigns in gold at a price of £3 17s. 10½d. per oz. Thus our standard coin has a well-defined legal weight and fineness and its value is constant. So in fact is a Bank of England note under Peel's Act. As a contrast to this —in our Colony of Hong-Kong the medium of currency is the Mexican and British silver dollar, and the fluctuations of the standard as compared with gold are enormous, unsettling and irritating. At one time the dollar was worth 5s., but last Christmas it touched 1s. 6d., and now (September, 1903) its value is 1s. 10½d.!

The Income Tax.

Peel, in 1842, imposed an income tax of 7d. in the £1—this is nearly equal to 3 per cent., or more exactly £2 18s. 4d. on every £100—not for the "purpose of providing the supplies for the year, but distinctly for the purpose of enabling us to make this great experiment of reducing other taxes." It was thus the precursor of free imports. The income tax has remained, and has proved most useful. It has varied very much with circumstances, but the mean for the last forty years has been 6d. per £1 or 2½ per cent., which is now regarded as the normal to which ere long we hope it will be reduced.

Taxation is direct and indirect, but they are not fairly distributed. There is a tendency to fly to direct taxation, because it falls upon the rich, but if it is excessive it must fall ultimately on labour, for the moment it pinches expenditure is reduced, horses, carriages, motors, yachts, boats, servants disappear, hospitality is restricted, and the circulation of money checked. The butcher, baker, fruiterer, grocer, tailor, milliner, *et hoc genus omne*, find their accounts diminish, demands cease, and the farmer, merchant, manufacturer, &c., pay off hands, and labour is in distress. Surveyed from every point of view stagnation in the circulation of wealth means want of employment and loss to the working man.

Peel's work of tariff reform was carried on and completed by his great pupil Gladstone. The French Treaty, negotiated by Cobden, and completed in 1860, while it modified immensely the restrictions between the United Kingdom and France, did not tend to the introduction of Free Trade between the two countries, and was only of a temporary character. It was not renewed. Gladstone's great financial coup was the abolition of all taxes on paper. His budgets were distinguished by the oratorical charm with which they were delivered. He ameliorated the incidence of the burden of taxation on the labouring classes to the lowest point, until, indeed, direct imperial taxation was wholly removed from them, but he also enunciated a doctrine which has been quite overlooked. "If you want to benefit the labouring classes," said he, "and to do them the maximum good, it is not enough to operate upon the articles consumed by them, you should rather operate on the articles that give them the maximum of employment." He was thus not averse to the taxation of food, and he recognised the equality of the claims of direct and indirect taxation, both for imposition and for remission. Indeed, it is only through the throat that you can force the working man to bear his fair share of the cost of government, while even this contribution from him is dependent on his being maintained in employment. If he be unemployed his aid disappears, and he and his family become a burden on his union or his neighbours. Local rates affect the working man much more than imperial taxes. If when at work he contributes £2 to the revenue, when he is a pauper he costs £15 per annum to maintain. Every working man thrown out of work means, on the average, five mouths left to feed, and thus £75 per annum has to be provided from the rates. There are over 1,000,000 paupers in the United Kingdom, that is 1 in every 40 persons is relieved by the poor-rates. Those who manipulate the fiscal system of this country are bound to reckon employment as a very potent factor in the consideration of any change.

Protection.

It is very remarkable that while so much solicitude has been shown by the politician for the welfare of the working man, the working man himself has established a form of protection more restrictive and more injurious to his own interests than the Corn Laws of old. The increase in the rate of wages, the reduction of the hours of work, the limit to the capacity of a day's work, the restriction of output, and the attempt to manage the business of the country by irresponsible agents are far more serious to the commercial supremacy of the country than any suggested fiscal reform. It is difficult to show how and where the shoe pinches, but every employer of labour, every contractor and manufacturer, every architect and engineer who draws up estimates, knows well that the cost and the amount of a day's work have recently materially changed for the worse. I shall revert to this point when dealing with statistics. The increased cost of production and of construction are far more injurious to our trade than any contemplated taxation. We are being beaten in every neutral market, at home and in our own colonies, by fair competition, and there is no difficulty in showing that the losing item is the growth of the cost of labour. For every 100 shillings received by the British workmen, the Frenchman receives 77, the German 78; but the German works 131 hours, and the Frenchman 124 for every 100 hours the Britisher works, and if the foreigner turns out more work per hour, as is maintained, it is not surprising that the British manufacturer is beaten in his own market. I write from personal experience, for in my professional work I have to deal with contracts in every quarter of the world. Moreover, the Americans and the Germans are better trained commercially, and the former particularly is more advanced in the employment of automatic machinery and of more perfect methods of production.

Unrestricted foreign competition has another evil. It handicaps the British working man not only against his own improvident regulations but against the high local rates and taxes

which follow from the cost of Empire and the free asylum we give to the distressed and conscientious foreign objector. Why should not the foreigner pay something towards the revenue of this country? He forces us to pay heavily to get our goods into his market, and we thus support the funds he allots to educate his people in those very principles of commercial and technical education which are employed by him against us as well as to strengthen his navy and therefore to compel us to spend more money on our own.

By our present unrestricted importation of partially or wholly manufactured articles, we also give a preference to other great manufacturing countries like the United States and Germany, for we enlarge their own free home markets by the addition of our own free home market without any *quid pro quo* whatever on our part. Thus the United States of America, with its population of 78,000,000 and our population of 42,000,000, has a market of 120,000,000, while we are restricted to our own 42,000,000. This gives the United States of America a decided advantage, because it is a well-known fact in production that the larger the quantity produced, within limits, the cheaper the cost of production. This is very marked in the case of steel, and an excellent illustration in the case of bricks was given by a correspondent in the *Times* of October 13th, 1903. He found he could turn out 60,000 bricks a week at a cost of 22s. per 1,000. He was, however, able, by a new process, to turn out 100,000 per week with the same labour, at a reduced cost of 17s. 3d. per 1,000.

Fawcett, whose work on "Free Trade and Protection" is a standard book on Political Economy, admits the right to impose import duties for revenue purposes on articles of food such as tea, sugar, &c., which are not produced at home and even on those which are produced at home like beer, when the excise duty is equivalent to the import duty. He thus admits that Free Trade exists between this country and another even when a tax upon a given commodity produced by each is equal. He, however, strongly objects to any import duty which implies directly or indirectly the protection of a special class of industry. We are all with him on that point, but when it becomes a question of the closing of markets to our own manufactured goods, of the loss of employment by our labouring classes, and of the disappearance of our capital, a general tariff on all manufactured goods may benefit all classes alike.

"Those who maintain high tariffs inflict a far greater injury upon themselves than they do upon us, but it cannot be denied that the English suffer as a nation by the commercial restrictions of other countries." This Fawcett said in 1881. What would he say now if he found loss of exports, diminution of markets, disappearance of capital, and want of employment? His argument is against high tariffs. He did not contemplate a low tariff which did not affect the market price at home, which fell on the foreigner, which benefited the British workman, and which gave the British Government something in hand to negotiate with when diplomatising with our competitors. Those who protest against import duties argue as though they were imposed for retaliation, punishment, or revenge, while those who support them argue that they will protect the home market, maintain more constant employment for capital and labour, and relieve the rates. Which is right? The so-called "Free trader" argues that taxation on imports must be paid for by the consumer and that prices in the home market must go up. If this were so why is it that we, the producers, suffer from the taxation of our exports into other countries? The repeal of the Corn Laws did not affect the price of bread, and the recent imposition of 1s. per quarter on imported corn was imperceptible in our markets. No sane politician would propose taxation that would raise the total cost of the necessaries of life or repeal the free importation of raw produce.

Reciprocity.

The true principle of Free Trade is reciprocity. Commerce is properly conducted when both parties who effect some exchange are mutually benefited. This has been our object in the past. Other nations do not do the same. Not one single nation has followed our lead. They are all for themselves. The result is that we are badly handicapped, and our workingmen must suffer for loss of trade means loss of labour in direct proportion.

We have striven to supply other nations with that which we can manufacture and supply cheaper than they can, while we have been willing to buy that which they can manufacture and supply cheaper than we can. But other nations have not agreed to this principle. They have striven and succeeded in beating us in our own markets with our own national commodities. Refined sugar, iron and steel, glass, machinery, cotton goods, silk, boots and shoes,

and many other industries have suffered, and we still turn to them the other cheek !

The historical facts I have endeavoured to establish, are :—

1. Peel is the author of our present fiscal system, which is a system of free imports, but which has been shorn of its chief merit—the maintenance of a home market.

2. Free Trade is something more than free imports. It is international reciprocity and cosmical commercial co-operation.

3. The United Kingdom has not been able to establish Free Trade anywhere, not even within its own boundaries. Its principles are scarcely understood, and are certainly not followed.

4. The great increase of the general trade, and of the wealth of this country, is not due to its fiscal policy, but to the revolution of business operations effected by the introduction of practical applications of science by which capital is more rapidly circulated.

5. We have not abolished protection, we have only transferred it from a place where it was controllable to a place where it is incontrollable, and injurious to the best interests of the country.

6. While we give no preference to our Colonies at present, we unwillingly give a virtual preference to our active competitors, by enlarging their home markets.

7. We exact from the foreigner no contribution whatever to the exp n es of Goverment, while he compels us to pay largely towards his expenses of education and defence.

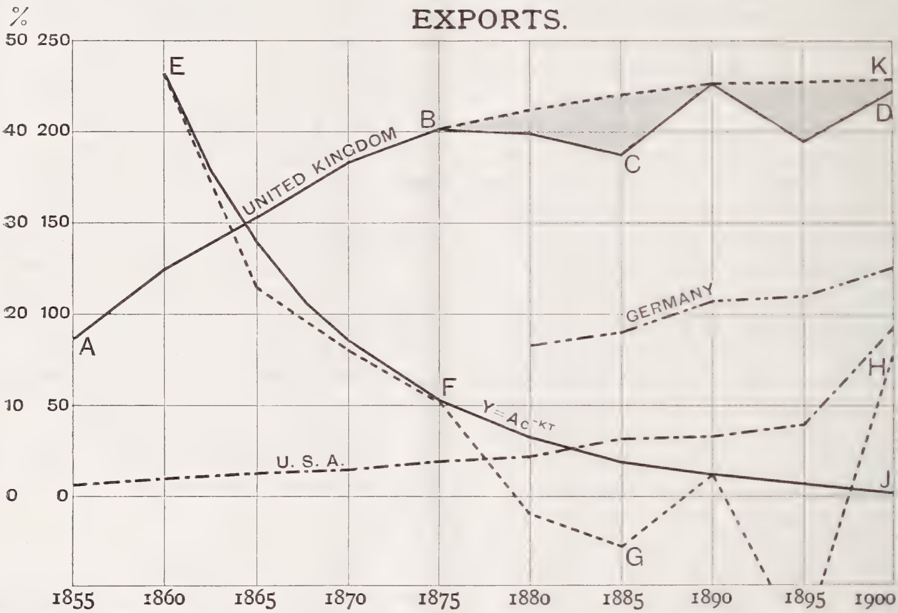
Statistical Facts.

The Fiscal Blue Book containing memoranda and statistical tables and charts collected by the Board of Trade issued in August last, is a mine of valuable financial facts. It is well supplemented by a smaller book on wholesale and retail prices published by the same Department in the same month. Doubt has been experienced of their absolute accuracy, and a note of caution on this point has been sounded by the Board of Trade itself, but I purpose to deal not so much with their *quantitative* as with their *qualitative* character. As long as they are relatively true over long periods they give the broad facts with which I wish to deal.

In accordance with the method I developed in my address of November 22nd, 1902, I have taken the table of *exports* of manufactured goods detailed in Section I., p. 3, and chart, Series A. This curve is shown as A B C D in Diagram I.

From this curve I have determined the percentage increase in the annual exports which is shown in the dotted curve E F G H. It will be seen that over the period 1860-75 E to F, this curve approaches very closely to a loga-

Diagram I.



rithmic curve $Y = Ae^{-Kt}$ in which Y is the mean percentage annual increase of the exports taken over periods of five years.

A is the basis of the curve taken from the first period free from any abnormal changes.
e is the basis of the natural logarithm, viz., 2·718.
K is the logarithmic decrement taken over the whole period.
t is any time or year considered.

From 1875 onwards there is a remarkable abnormal falling off. Continuing the logarithmic curve to J, we see what would probably have been the percentage growth had no abnormal variations occurred. Assuming therefore that the growth had been as shown by F J. I obtain a continuation of the export curve B K, which would have been the true curve of exports onwards had matters followed the normal. In that year (1875), there commenced a remarkable stagnation which, with considerable variations, has continued ever since.

I show on the same diagram the actual growth of the exports from Germany and the United States, and though no striking change is visible until 1896, there then comes a bound up in each country, which may account for much of the loss of exports from this country. The area contained by the dotted line B K and the solid curve B C D, is a measure of the trade lost by this country during the twenty years, from 1880 to 1900. It represents £412,000,000, and if one half of the value of this business represents labour, and the change is due to new fiscal systems of other nations, then it means that the working classes lost £206,000,000 by the trade operations of foreign countries during those twenty years.

I next give a similar kind of diagram showing the *imports* of manufactured goods into this country including those from the United States, Germany and France. Repeating the same procedure as in the case of exports I obtain, in addition to the curve A B C D, which shows the actual amount of imports, a curve B C E, derived from the logarithmic curve F B G, which shows what the imports would have been had the rate of growth been normal and in the same proportion to the growth from 1855 to 1880. It is seen that there are two areas B C and C E D, which give us trade gained or lost in the period 1880-1900. It shows a net increase of imports of £80,000,000, which means a loss of home trade, in addition to the loss of £412,000,000 in our export trade mentioned above. To what is this to be attributed?

1. Is it due to our having reached the limit of our producing power at home?

2. Is it due to fiscal prohibition in other countries?

3. Is it due to the successful competition of other countries in our own markets?

4. Is it due to the emigration of capital to that prohibitive, but rapidly developing country across the Atlantic and elsewhere?

There are no statistics to enable us to answer these questions, and they are of sufficient importance to justify special enquiry.

The last query is of great importance to our working classes; for at home capital and labour work hand in hand, they are essential to each other, but if capital emigrates to another country, it is the other country that finds the labour, and our people at home go to the wall.

Prices, Labour, and Cost of Living.

The changes in the level of prices of all commodities, shown in Diagram III., taken from the report of wholesale and retail prices, upon which the logarithmic curve is drawn, indicate that a slow, steady decrease has occurred since 1800, but varied at times by wars, famines, commercial depressions and elevations. It is clear, however, that the law has not been disturbed by any fiscal changes, though there is a very remarkable temporary fall in 1850, following probably the repeal of the Corn Laws in 1846.

The diagram also shows changes in the general level of money wages during the period 1860-1902, taken from the Fiscal Blue Book, (Appendix xix., p. 259), by which it seems that again a general law is at work, raising by regular continuous movements the percentage growth. This change is very nearly the same in all countries. It may be due to similar causes, and if so, it cannot be due to Free imports, for other countries have applied the reverse policy of Prohibition. But the curve showing the cost of living is more startling, for it shows a very considerable decrease in the period 1878-1902. The working man in the United Kingdom can now buy for £5 what cost him a quarter of a century ago £7. That in the United States from 1883 to 1900 exactly coincides with the United Kingdom. The improvement in France and Germany has been much less, in fact the cost of living has been practically stationary. We have here distinct evidence of some advantage we have gained in the United King-

Diagram II.

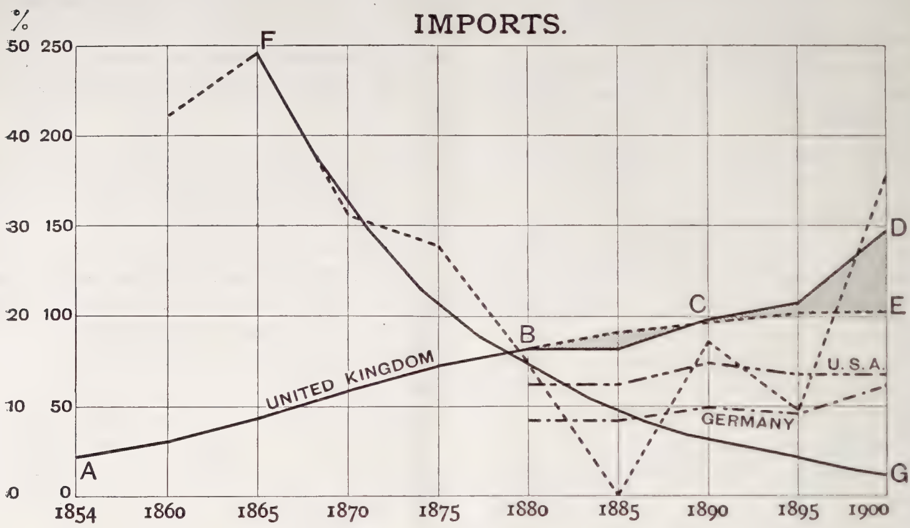
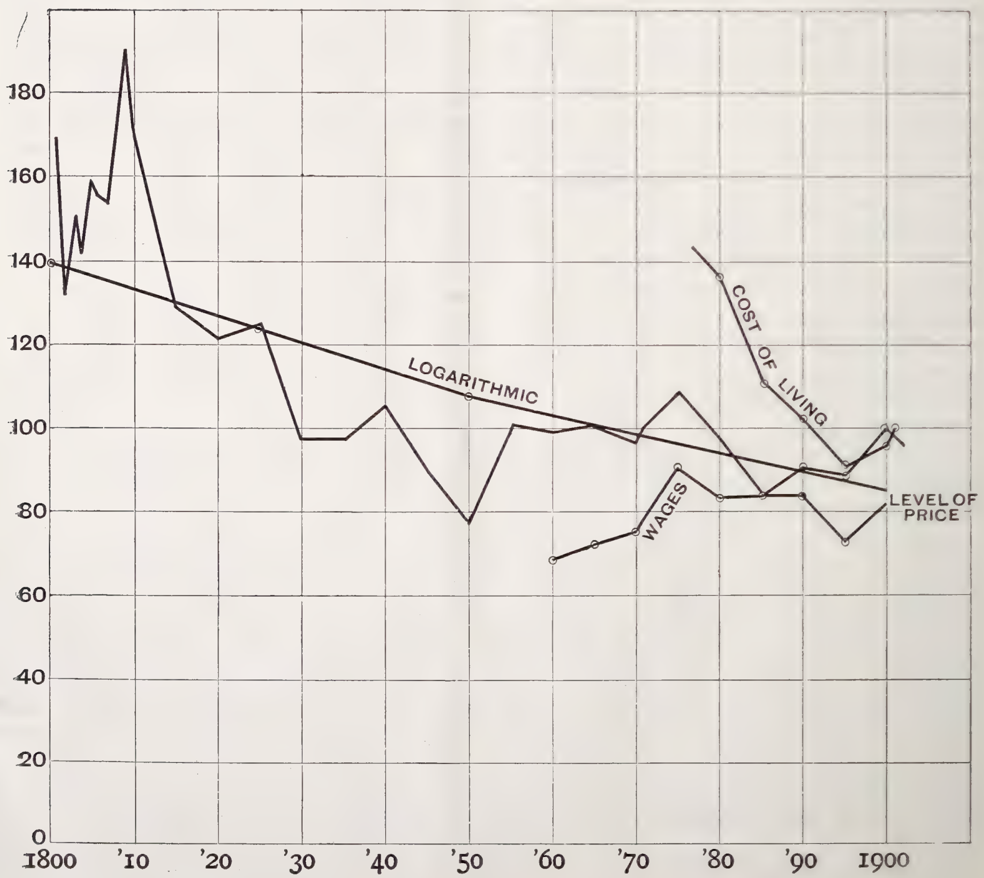


Diagram III.



dom over France and Germany. As regards food stuff, the United Kingdom and the United States pay no duties. But, on the other hand, both these countries have received great benefit from engineering improvements and the reduction of freights. I have menioned that wheat, which in 1873 cost 7s. per quarter to be transported from New York to Liverpool, cost only 10d. in 1901. The repeal of the Corn Laws in 1846 was followed by a rise in the price of wheat, and when the import duty of 1s. per quarter was finally removed in 1869, again the price of wheat actually rose! It is therefore difficult to argue that the reduction in prices is due to the removal of taxation. In fact the most careful examination of the tables and the curves in the Fiscal Blue Book fails to show any influence of fiscal changes on prices. We must rather look to improvements in the methods and economy of production, in the convenience and rapidity of transportation, in increased facilities for the conduct of business, and for the storage and distribution of materials for the great benefits that we have experienced.

Wheat.

I will examine the case of wheat. In 1846 the local price of wheat per quarter was in—

	s.	d.
Dantzic	35	0
Transport and intermediate charges .	10	6
Duty in England	20	0
	65	6

	s.	d.
Odessa	26	0
Transport and intermediate charges ..	15	0
Duty in England	20	0
	61	0

The home price was taken as 50s.*

The cost of producing wheat in Canada per acre has been very carefully calculated and described.

The average yield is 18 bushels per acre, and the selling price in the local market 2s. per bushel or 16s. per imperial quarter. This means a profit to the farmer of 3s. 6d. per acre after paying labour, rent, and interest on capital. The Americans are trying by a combine to enforce a uniform charge of 4s. per bushel.

The operations of the Canadian farmer are ploughing, seeding, harvesting, thrashing, and transport to market.

* "Annual Register, 1842," p. 31.

If we assume that every 1 lb. of wheat becomes 1 lb. of bread, then the consumer in London pays 60s. per quarter when the quartern loaf costs 4d.* How is the difference of 44s. to be accounted for?

Dealer No. I. buys his wheat in the local Canadian market. His operations are—1. Buying. 2. Transport to port *viâ* railway. 3. Storage in docks.

Dealer No. II.—4. Buys and pays freight. 5. Storage in bonded docks in England.

Dealer No. III.—6. Buys in England; pays tax (if any). 7. Distributes to English markets.

Dealer No. IV.—8. Purchases in local market, or in Mark-lane. 9. Distributes to miller.

Dealer No. V.—10. Miller sells to shop.

Dealer No. VI.—11. Baker makes into bread and distributes to (12) consumer.

Here we have twelve distinct operations, each one of which demands a portion of the balance, and if the balance be equally distributed over them all, then each operation absorbs 3s. 8d. per quarter.

Who pays the import tax? Is it Dealer No. II. or Dealer No. III.? If the import duty were as it was, 1s. per quarter, then the mean cost per transaction would be 3s. 7d. If 2s., then 3s. 6d., the same as the farmer earns in Manitoba. It seems an absurdity to imply that the consumer would pay the tax when there are so many interested merchants wishing to take the risks of business, amongst whom it can be distributed, and whose profits are so great that a mere 1d. or 2d. difference would be immaterial. It was a very different thing in 1846, when a duty of 20s. was imposed, then the tax, as my figures show, was prohibitive. There is a vast difference between a high prohibitive tax and a low defensive tax. The former falls chiefly on the consumer. This is shown by the fall in our own exports—the foreign importer prefers to buy in his own market. It is shown by the tin plate business in America. It is shown by the price of corn in Germany and France. But when a tax is merely nominal, as the 1s. export duty on coal and the 1s. import duty on corn, it is quite impossible to perceive, either in the tables or charts, any effect on the markets. Only last September the price of wheat fell 5s. per quarter, but it had no effect on the price of bread. Those who argue that taxation falls on the consumer, invariably rely for illustration

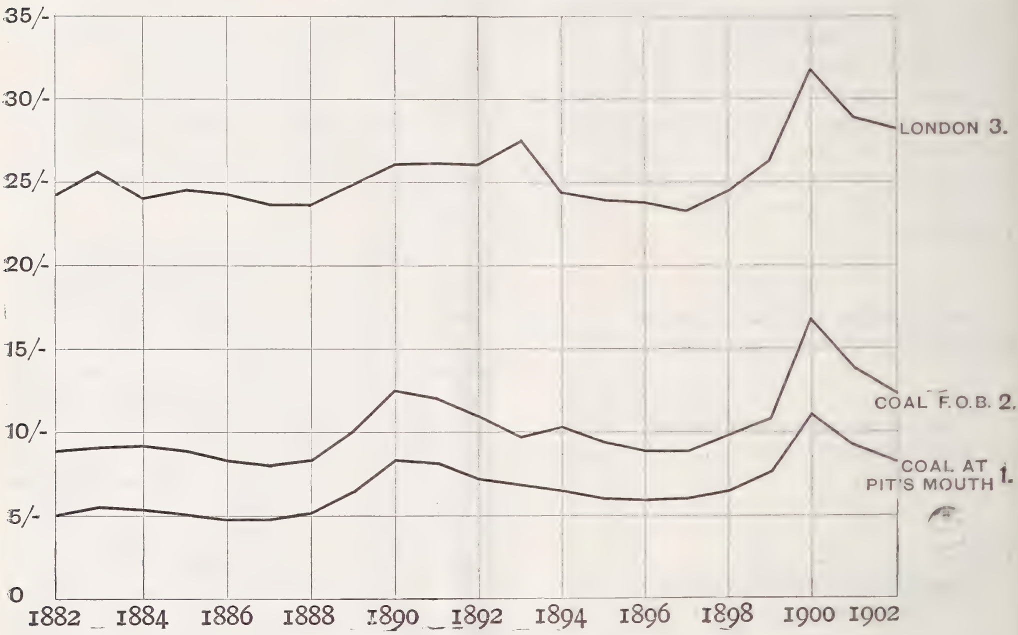
* He really pays more, for 1 lb. of wheat does not give 1 lb. of bread.

upon very high tariffs—in fact prohibitive duties—and on this point there is no difference of opinion. The true art of fiscal policy appears to be to adjust the tariff so that while on the one hand the tax adds materially to the revenue, it does not interfere with the market, and it gives a weapon to favour a preferential treatment of those countries which are prepared to deal fairly with us. With free imports of wheat from Canada, the 2s. tax must be paid by the exporter in the United States, and it would certainly stop the operations of any combine in the United States to raise the price of wheat to 4s. per quarter. While the price of wheat in New York is virtually the same as that in London, the price of the quartern loaf which is now 4½d. here is in New York 10d. The American citizen pays heavily for the vagaries of his peculiar fiscal system.

While the cost of living has materially diminished and the general course of money-wages has increased, how has the mean work turned out by the individual workman, per unit time, day or hour, fared? There are no statistics dealing with this point, but there is an admirable memorandum in the Blue Book discussing the matter. It is a most important subject for economical consideration. It determines the manufacturer's or producer's price to the consumer, and decides the rejection or acceptance of tenders. I have already referred to the deterioration in the capacity for work turned out per day, and to the action of trade-unionism; but there are other matters influencing the character of many classes of our working men that are causing much concern to his employers—intemperance, gambling, irreverence, and sport.

It is difficult to draw any conclusion as to the relative merits of foreign and British workmen in the absence of complete returns, for the difference in the value of money, in habits of people, rate of wages, hours of labour, and modes of payment, are so very variable in different countries. American wages in many trades are nearly double those in the United Kingdom, nevertheless it is asserted that the works cost per unit of work done is the same in each country. If this is so, and I believe it to be true, it shows that the American workman does much more work per hour than the Britisher. I have visited the United States several times and I have had many opportunities of studying the working man there. I have the highest opinion of his ability and capacity. He lives in a better atmosphere than our men at home, and he is filled with loftier aims. "We are all sovereigns here," said one of them to me. The patriotism of the American of every class is his distinguishing feature.

Diagram IV.



Coal.

It is estimated that 227,095,000 tons of coal will be raised in the United Kingdom in 1903. Of this 30,000,000 (Fiscal Blue-book, p. 97) will be exported for the use of our foreign competitors. The total coal production of the world is about 700,000,000 tons, of which this country produces rather less, and the United States rather more than a third. Our Colonies produce about 24,000,000 tons. The export tax is 1s. per ton. Peel made it 4s. per ton. Why should it not be restored to this? Coal is virtually the only raw material which we export. The supply is limited. It must come to an end. What will posterity say to those politicians who have wilfully allowed our competitors to rob us of our chief support, and hastened the decay of our country? Their policy is suicidal. If prohibition were ever justifiable, it would be in the case of coal.

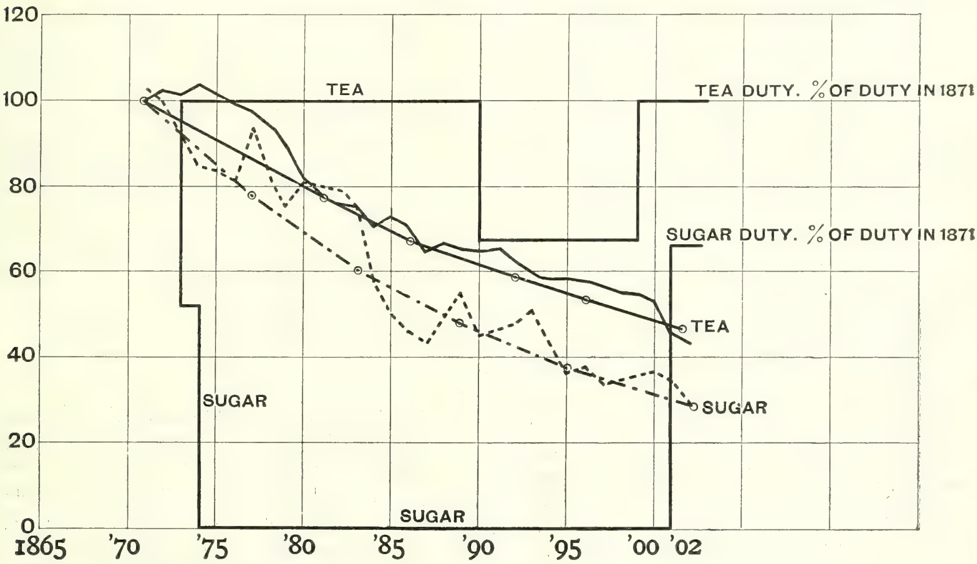
I give a diagram IV. showing during the period 1882-1902 (1) the estimated value of a ton of coal at the pit's mouth; (2) the declared value F.O.B. at the exporting port; (3) the price paid by the consumer on delivery in London.

Space alone prevents me from analysing the distribution of this enormous difference. It was estimated by Fawcett that in 1872, when a great rise took place in the retail price of coal, "no less a sum than £81,000,000 was taken in a single year from the consumers." In the West Yorkshire district, between October, 1871, and March, 1873, there was an advance in the price of coal at the pits' mouth of 15s. 6d. per ton, while wages in this period were advanced only 1s. 1½d. a ton.

Tea and Sugar.

Diagram V. shows the influence of taxation on the prices of tea and sugar during the period 1871-1902. A mere inspection of the diagram upon which the logarithmic curve is drawn, is sufficient to show that fiscal action did not affect market prices. In spite of the fact that duties were imposed the fall continued. Even when the duty was relaxed on tea in 1890 the market price rose.

Diagram V.



Iron and Steel.

The iron and steel business in the United States has attained gigantic proportions. In 1902 the total production of pig iron was 17,821,307 tons, an increase of over two millions on 1901, over four millions over 1900, and double that of 1897. This far exceeds their own demands, and to maintain their large economical output they are "dumping" their supplus production in our open market and supplying our shipbuilders and ironmasters at prices much below the market price. Germany for similar reasons has been sending here girders and shipbuilding material, steel bars and billets for making sheets, tin-plates, bars, and wire, and selling them below cost price. Our manufacturers are bound to buy in the cheapest market, and in their own defence

they must take advantage of this action of America and Germany. It is the ironmasters and the home-labour class that suffer. How far a change in our fiscal system will check dumping is not clear, for it is evidently a temporary and exceptional proceeding, but that all manufactured articles of iron and steel imported here should contribute something to the revenue of the country must, I think, be evident to the business man who carefully considers the facts.

THE EMPIRE.

The South African war showed that there was a true ring of patriotism in the British Empire, but the parochial squabbles of British statesmen in party warfare, "must give us pause." Cecil Rhodes, the broadest minded man I ever met, had visions of a great empire. He wrote: "The whole thing lies in the question, can we invent some tie with our mother country that will prevent separation? It must be a practical one. The curse is that English politicians cannot see the future."

Mr. Chamberlain is desirous to restore preferential tariffs with our colonies, to knit together more solidly by commercial links the patriotism of our race. A firm fiscal system means the unification of the British Empire. What would Greece have been if all her colonies had been connected together by such ties as even now bind the British Empire? or what would it have been if it had anticipated the dream of Cobden of co-operation in business, and of amity in trade? She failed because she committed upon herself an unhappy despatch. Her existence was meteoric. Having all the elements of a magnificent Empire—numbers, valour, strength, physique, climate, brains, knowledge, undying literature, inimitable art; her states, her colonies, and her heroes destroyed each other, and she was obliterated as a nation by Rome. Had Pericles been allowed to have his way there would have been a great Grecian Empire.

Spain lost her colonies, and where is she? Our colonies are coming to our help and there is sunshine through clouds. Several colonial congresses have been held where this important question has been discussed. The first took place in London in 1887, when the feasibility of promoting closer union between the various parts of the Empire by means of an imperial customs tariff was the main subject considered The next congress took place in Ottawa in 1894. The expressed desire of the colonies was to secure reciprocity of treatment, and open markets for their products. Preferential rates within the Empire were favourably considered. The next congress was held in London in 1896 under the presidency of Mr. Chamberlain. The principal subjects discussed were the closer union of the Empire through commercial co-operation, and the exclusion of the idea of taxing food and goods with any view of raising prices. In 1897 Canada passed an Act giving the United Kingdom a 25 per cent. preference on all imported goods; it is now $33\frac{1}{3}$ per cent. New Zealand has followed suit. In 1901 a meeting of Colonial Premiers took place in London, again under the presidency of Mr. Chamberlain, and the present great fiscal political turmoil is a consequence of the discussions that then took place.

What will be the end of it? Let us hope a more scientific fiscal policy at home, an elastic revenue, greater credit, continuous employment for our working men, reduction of poor rates, a united, self-supporting, self-contained, impregnable Empire, which, with the aid of the United States, will eventually make the Anglo-Celtic race the dominant and controlling power of the world, fulfilling the first object of the great mission —"Peace on Earth."

DISCUSSION.

Sir GUILFORD MOLESWORTH, K.C.I.E., said that he thought that the chief objection to the proposed fiscal policy lay in the fallacious assumption that the duties would involve an increased price to the consumer. Experience showed the contrary. Prices, especially those of corn, were determined by the world's level of prices, and that level was determined by all sorts of conditions, such as currency, production, and transport. It might be laid down as a grand axiom that when an article was of home production a duty which was not prohibitive would not raise the price. It stimulated home production, and as a rule the burden of the duty fell upon the foreigner. When the article could not be produced at home, the burden of the duty fell upon the consumer. To unthinking persons or shallow thinkers this appeared very paradoxical; but many facts influenced the question. The duty on wheat in France in 1884 was 1s. In 1885 it was raised to 5s. 3d., but the price of wheat did not rise. When, however, the duty was raised to the prohibitive rate of 12s. $2\frac{1}{2}$d., the price rose. The same thing was true as to Germany and Italy. A committee of the Belgian House of Representatives reported in 1891 that when duties were imposed on wheat the price fell. In the Colony of Victoria, where there was an export duty of 9s. 8d. a quarter on wheat, bread was cheaper than in New

South Wales, where wheat was admitted duty free. The reason was that the Victorian farmer, being protected against foreign wheat, was able to grow corn with confidence, and he went in for growing it more than he would have done under other circumstances. The history of the Corn Laws in the latter part of the 18th century showed similar results. The abolition of the Corn Laws in 1765 was followed by a rise in wheat from an average of 33s. 3d., to an average of 42s. 2d. In 1801 or 1802, when there were practically free imports, the price rose to 119s. 6d. a quarter. Select committees reported, in 1813 and 1814, that the high prices which then existed, when there was virtually free trade, were due to undue dependence on foreign supplies, and they advised that the Corn Laws should be re-enacted. In 1835, the price fell to 39s. 4d. under a strict Corn Law. It was generally supposed that Corn Laws kept up prices to the limits of free imports, but that was not the case. Free import into England naturally caused a demand of the foreign supplies, and there was a tendency for the foreign supplies to rise. The paper stated that Adam Smith was the father of free trade, and he was; but the free trade of Adam Smith was very different from the free trade of the present day. Adam Smith argued against monopolies, prohibitions, and high prices, which amounted to a prohibition. It was absolutely against his principles that we should have manufactured articles free; and he said that, if there was free import for manufactured articles, English manufacturers would, to a certain extent, be ruined. Adam Smith never contemplated such changes as had now taken place, and he would never have advocated the free import of corn if he had known that it would have amounted to 1,800 times the amount which he had fixed as the extent to which corn might be imported without damaging the farmer.

Mr. J. W. WILLANS said that they had in the paper a political discussion, and he did not know whether the meeting could return to scientific lines. In 1872 and 1873, the whole course of prices was inflated by the Franco-German war, and Scotch pig iron, which had been generally from 50s. to 60s. a ton, went up to 105s. or 106s. Cotton, which in 1900 was as low as $4\frac{1}{2}$d., stood at $10\frac{3}{4}$d. in 1873. In the same year, a recognised quality of English wool rose from the normal price of 9d. or 10d. a pound to about 2s. 2d. These high prices were due to the war, and when the war was over there was a great collapse of prices. In 1885 and 1886 there was a Royal Commission on the Depression of Trade; but when that Commission reported they did not say that the depression was due to foreign tariffs, and the great disadvantage which England suffered in allowing foreign productions to have a free market, while foreign markets were protected against English goods. On the contrary, the Commission said that England had better go on as it was, and keep its markets free, whether other countries kept theirs free or not. Mr. Gladstone, quoting in part from the words of Scripture, and adapting them to meet the case, said, "If a nation smites you on one cheek by a protective policy, and you imitate them, and have a protective policy because they have one, you will smite yourself upon the other cheek." That is just what would happen. If we kept our own markets open we should be open to compete with all the world in every market of the world. It was a mistake to suppose that the price of corn was not increased by an import duty. Of course, in the main, the price went up and down according to the yearly production, independently of the amount of duty. The great controlling influence in price was the amount of production and the demand for the produce. The duty was a percentage added to the market price. Another element in the reduction of the prices of foreign wheat was the reduced cost of transport from the other end of the world. In 1849, when the abolition of the corn duty took effect, there was a fall in the price of wheat equivalent to the exact amount of the duty which was then taken off, namely, 6s. a quarter. In 1850, the price fell further, and, in 1851, it was lower still. Then came the Crimean War, and the price immediately went up. In 1855, it reached 74s. 8d. But that rise was independent of any question of duty. The differences between the prices of corn in England, and the prices in France and in Germany were as nearly as possible in correspondence with the amount of the duty of the latter countries. This fact was shown by official figures. Duty was an increase in cost price. It was all nonsense to say that the duty was paid by the foreign importer and not by the consumer. Duties of 5 or 6 or 10 per cent. could not be imposed without the consumer paying them. There were cross currents which tended to affect the exact degree in which the consumer seemed to bear the impost, but fact was that the cost of the duty was borne by consumers living in the country which imposed it.

Mr. L. GASTER, without wishing to discuss the fiscal side of the question, emphasised the fact that in order to enhance the welfare of the working classes and the industrial development of this country, it was very essential that more encouragement should be given to the free development of the individual effort of the workmen, and not to hamper them by the limitation of the day's work or the restriction of output, &c. In order to reduce the cost of labour more liberal employment should be made of automatic machinery and the adaptation of more perfect and newer methods of production, and where possible a greater use should be made of the now unutilised by-products, as, for instance, the blast furnace gases, &c., which would contribute to reduce the cost of many manufactures. If in some of the trades a home demand were created, bigger than we are prepared to supply at present, advantage should be taken of the experience gained by the other nations in

these trades, and he believed that a harmonious co-operation of the foreign experience in these trades, with British capital and labour, would be beneficial to the development of these industries in this country, avoiding to a large extent the importation of those goods at present manufactured abroad.

The CHAIRMAN moved a vote of thanks to Sir William Preece for his paper, coupling with it an expression of sympathy with Sir William in the illness which prevented his being present at the meeting. He did not think that he could agree generally with Sir William in what he had written, but it would not become him as the chairman to criticise the paper. But he believed, emphatically that, as the writer had said, they must not ascribe the prosperity or adversity of a country entirely to its fiscal policy. Nothing could be more ridiculous then to take such a view. Prosperity was due to industry, to inventions of all kinds, and to the diminution in the cost of production and other matters of the same class, for which we were indebted to men of science. The scientific man was the enemy of the protectionist by helping to reduce the cost of production, and, when the people were deriving benefit from that cause, the politician came along and said, "You shall not enjoy this benefit, and you shall be charged so much more for the goods you buy." There was an impression that the trade of this country had been injured by the tariffs of foreign countries. It was true that those tariffs had done our trade some harm, but they had done more harm to the countries which had imposed them. No protectionist country was out and out protectionist, and no tariff that had ever been devised could keep English goods altogether out, for every country must admit those goods for its own purposes. It would be found, for instance, that half the goods which went into the United States, the leading protectionist nation, went in free of duty. It was very important to remember this fact. In other cases where foreign countries imposed duties, the duties were often not protective but were analogous to such duties as we ourselves had on tea—revenue duties. It was not the case, therefore, that the trade of this country was being destroyed by the tariff walls which other countries set up against them. If foreign countries chose to establish a tariff to tax articles which their people must have, that was their affair. The goods must go in. The tariffs might, perhaps, be inconvenient, but they were no worse than the duty which England imposed upon tea for the purpose of the revenue. That duty was practically 100 per cent., but it did not exclude the article. England had a much better prospect for its foreign trade than some people led us to suppose. With regard to what Sir Guilford Molesworth had said, he would remark that the country which put on a duty could not expect that the consumers would escape from paying it. Suppose that a 2s. duty was put on wheat to-morrow, the home buyer would go down to the docks to meet the foreign merchant, and would put to him this plain question, "What is the price of your wheat with the duty, and what is the price without the duty?" He was sure that the price, without the duty, would be exactly 2s. less than the price with the duty. Of course the dealer would not pay the duty out of his own pocket, but would get it back ultimately from the consumer. That seemed to be the common sense of the question, and there was no necessity to reason the matter out at great length. Some of the discussions as to the possible incidence of the duty upon the foreign taxpayer, really involved most difficult questions of statistical and economical reasoning, and they belonged to the category of history. If we wanted to study not merely the immediate effect, but the ultimate effect, of any particular economic measures which we adopted, whether for increasing the cost of production or for diminishing it, and to trace the various indirect effects of the action which we took, the investigation in which we engaged for the purpose would be a very interesting one, but it would be no part of practical business. The practical business man certainly tried to get the duty out of the person to whom he sold the articles on which the duty was imposed.

The vote of thanks was carried unanimously.

Miscellaneous.

THE AUSTRIAN COTTON INDUSTRY.

Owing to the prevailing uncertainty and apprehensions of a tariff separation between Austria and Hungary, the Hungarian market, upon which the Austrian cotton mills greatly depend, continues in a very bad condition. Hungary had, up to a few years ago, no textile industry of its own, and it has been supplied almost entirely by the Austrian manufacturers. The bulk of the cotton used in Austria is imported from the United States, while only a small percentage of East Indian and Egyptian cotton finds a way to the Austrian market. During 1902 the total consumption of cotton in Austria amounted to 318,644,000 pounds, of which fully 220,460,000 pounds were American. The cotton is shipped from the United States to Bremen or Hamburg, and thence forwarded by rail, or on the River Elbe, to its destination. No cotton is grown in Austria, all attempts to cultivate it, including recent experiments in Hungary, having signally failed. As regards the cotton mills, Bohemia, according to Consul Watts, counts the greatest number of spindles, so that the largest portion of cotton imported remains in Bohemia. The mills manufacture chiefly the coarser number of yarns. The official returns for 1902 give the following number of spindles in operation:—Bohemia, 1,750,000; total

for Austria-Hungary, 3,128,000. The import and export of yarns is comparatively of little importance, excepting of the finest numbers, which are regularly imported. The weaving establishments turn out ordinary calicoes, jacquard, and fancy tissues, and other coloured goods, which are fully up to the modern standard. The number of looms is about 110,000, of which about one-half are in Bohemia. Respecting the finishing industry, the bleaching and laundry establishments, and in connection therewith the shirt and collar factories, are in a state of great efficiency, and the last-named industry is extending its trade into all parts of the world. Dyeing and printing works are also fitted up with modern appliances, and if the export of their goods is not of any importance it is due to the unfavourable tariffs, which increase the cost of dyeing material, &c. The number of printing machines in operation is estimated at about 150, of which about one-half are in Bohemfa. The daily working hours vary between ten and a-half and eleven and a half. Some of the printing establishments in Eastern Bohemia run their works day and night. Wages paid to regular hands in the cotton mills vary from 2s. 6d. to 4s. 3d. per day. The wages of weavers are comparatively less ; even in districts where the highest wages are paid they will hardly earn 2s. 6d. per day, while in the calico establishments in Eastern Bohemia they get scarcely more than 1s. 8d. per day. Of course, in cases where a weaver serves four looms, or where particularly skilled hands are required—as for instance for Jacquard looms, &c. — the pay is considerably higher.

ADMIRALTY CHARTS.

The following is the official list of charts issued by the Hydrographic Department of the Admiralty, in September and October last :—

New Charts.—No. 2167—Scotland, north coast; Firth of Cromarty. 1596—Harbours and anchorages on the coast of Italy; Salerno bay; Port Salerno; Port Torre del Greco; Port of Naples. 1687—Sicily; Messina harbour. 3351—Greece, south coast; Port Skutari. 3379—Mexico, south-west coast; Pichilinque harbour. 3380—Persian gulf; Bahrein harbour. 3349—China sea; approach to Kwang chau wan. 3280—China, east coast; Hongkong waters, west. 3294—China; Yang tse Kiang. Hupeh province:—Hankau. 3378—China, north coast; Rocky point to Temple head. 3352—Tasmania, west coast. Port Davey:—Bramble and schooner coves. 3322—South America, north-east coast; Orinoco river; plan added:—Cano Imataca (Rio Corosimo).

Charts that have received additions or corrections too large to be conveniently inserted by hand, and in most cases other than those referred to in the Admiralty Notices to Mariners :—

Nos. 2793—England, south coast; Cowes harbour. 2076—Scotland, north coast; Loch Eriboll. 3158—Norway; Nevlunghavn to Torbiornskier. 3159—Norway; Torbiornskier to Jælöen. 3160—Norway, Torbiornskier to Rauö. 2298—Baltic sea, Gulf of Bothnia; Nystad light to Stor fiärd, 2299—Baltic, Gulf of Bothnia; Hornslandet to Stiernö point. 2368—Germany, north coast; Jershöft light to Rixhöft light. 201—Adriatic sea; the coasts of the Gulfs of Venice and Trieste. 1986—Gulf and River St. Lawrence; Buctouche river. 2892—East coast of United States; Narragansett Bay. 1325—Chile; Gulf of Penas to the Guaytecas Islands. 2248—British Columbia; Haro Strait and Middle channel. 584—British Columbia; Clayoquot and Barkley Sounds. 20—Persian Gulf; Bahrein Harbour. 1750—Australia, south coast; Port Adelaide. 1070—Australia, east coast; Port Stephens. 214—Solomon Islands.

These charts are issued by Mr. J. D. Potter, 145, Minories.

THE GERMAN TOY INDUSTRY.

The manufacture of toys in Germany is an industry which gives employment to fully 50,000 people. The total value of the annual exports amounts to £2,640,000. The prosperity of the industry, like a great many other important branches of manufacture in the German Empire, is dependent upon the importation of certain raw materials, such as lead, coloured glass, rubber, nickel, porcelain, hair lace, tin, leather, &c., from abroad. Many of the articles used are produced in Germany, while others are imported in part or entirely from foreign countries. The manufacture of toys in Germany has been centred chiefly in the cities of Nuremberg and Sonneberg, while many domestic branches of manufacture which are mainly associated with the industry, have sprung up in the surrounding country hamlets. These two cities have become famed for the quantity of their products, and the important place which they hold in the commerce of the world to-day, is due chiefly to the fact that they supply fully 80 per cent. of all the toys exported from the Empire. According to Consul Harris, of Eibenstock, the manufacture of toys has become important as a domestic or house industry among the people in the little principality of Meiningen, and the small villages in the country about Sonneberg contain many skilled wood carvers and cabinetmakers. In the vilfage of Hämmern, toy ships, large and small, are carved by persons who have never seen a sea or a navigable river. Judenbach and Neuenbau furnish pictures, mirror frames, and fancy boxes. Eisfeld has two factories which make hobby horses. Schalkau and Ehnes produce wooden guns of every size and variety, while in Mengersgereuth, Schichbsböhn, Fichtoch, and Effeldere such playthings as rattles, waggons, trum-

pets, whistles, and toy animals are manufactured in large quantities. The making of doll's clothing is confined chiefly to Sonneberg and is almost entirely the work of women and girls. Carnival masks are prepared in Heinersdorf, while animals and fowls are fitted up with furs and feathers in the little village of Neufang. These country villages are clustered about Sonneberg and form one of the chief supports to the more highly developed industries in that city. The Sonneberg toy industry consists in the main of papier maché goods, which are gradually pushing wax dolls out of the market. This is due in part to the difficulty of producing a wax doll which is not fragile in structure and sensitive to touch and climate. Sonneberg produces dolls of almost every imaginable variety. They cost from sixpence a dozen to fifteen shillings each. There are more than 30,000 people engaged in making toys in Sonneberg and in the villages of the Thuringian forest, while fully 75 per cent. of this number work in their own homes. The main difference between the industry of Sonneberg and that of Nuremberg lies in the fact that the former consists principally of the manufacture of hand-made toys supported by a highly developed house or domestic industry, while the latter manufactures toys with machinery, in factories equipped with all modern appliances. Another marked difference between the two industries is that the products of Nuremberg are principally of metal—tin soldiers, swords, railway trains, fleets, models of machinery and other toys intended for boys, while Sonneberg uses almost exclusively wood, porcelain, glass and paper in the production of toys best suited to girls. During the past seven years the home demand for German toys has been on the increase. The German trade generally speaking calls for toys of the cheaper sort, and the stores which have been established in many of the large cities during the past few years, buy large quantities of them for advertising purposes. The future prosperity of the industry will depend very largely upon the ability of German statesmen to secure favourable commercial treaties and foreign countries. In the present commercial treaty, negotiations with Switzerland and Russia, toys are playing an important part.

WILLIAM GILBERT'S AUTOGRAPH.

At a meeting of the Society of Electrical Engineers on Thursday, 10th inst., in commemoration of the tercentenary of Dr. William Gilbert's death, a picture representing "the father of electricity" in the act of shewing his electrical experiments to Queen Elizabeth and her Court, was presented to the borough of Colchester, in which place Gilbert was born in 1544. At this meeting, Dr. Silvanus Thompson, F.R.S., exhibited the copy of the first edition of Gilbert's great work, entitled "De Magnete," 1600, which is in the possession of the Society of Arts. This is of peculiar interest, as not only is it a presentation copy from the author to his friend Lancelot Browne, but it also contains a correction of one of the diagrams and a long note on the back of another diagram in the handwriting of the author. The inscription on the title page in Gilbert's autograph is rather difficult to decipher, but appears to be as follows:—"Sum Lanceloti Brunii Medici Reg mei ex dono authoris, 1600 Aprilis 6°." Dr. Browne, the latinised form of whose name appears in this inscription, succeeded Gilbert as President of the Royal College of Physicians in 1603; he was at the date of the publication Physician to Queen Elizabeth. A medical certificate, addressed to Sir Francis Walsingham by Dr. Gylberde (*sic*) and Lancelot Browne, discovered by Dr. Silvanus Thompson in the Public Record Office, is printed in the *Journal* for April 11th, 1902 (see vol. l., p. 487). There is a presentation copy of the book to Thomas Langton, in the library of the Royal Institution, which is also dated April 6th.

WORLD'S PRODUCTION OF RUBBER.

The following table showing the World's production of rubber in 1902, with comparative figures for 1900, taken from the *Board of Trade Journal*, has been compiled from estimates published in "Industrie et Commerce de Caoutchouc":—

Country of Production.	Quantity Produced.	
	1900.	1902.
	Tons.	Tons.
Brazil, Peru and Bolivia	25,000	30,000
Other States of South America ..	3,500	1,000
Central America and Mexico	2,500	2,000
Straits Settlements and Dependencies	..	1,000
East and West Africa and the Congo country	24,000	20,000
Java, Borneo, &c.	1,000	..
Madagascar and Mauritius	1,000	..
India, Burma, and Ceylon	500	..
Total	57,500	54,000

MEETINGS FOR THE ENSUING WEEK.

MONDAY, DEC. 21...Bibliographical Society, 20, Hanover-square, W., 4½ p.m. Annual Meeting.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Dr. Thomas Ernest Stanton, "On the Resistance of Plane Surfaces in a Uniform Current of Air."

Journal of the Society of Arts.

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FRIDAY, DECEMBER 25, 1903.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

JUVENILE LECTURES.

The usual short course of lectures adapted for a juvenile audience will be delivered on Wednesday afternoons, January 6th and 13th, at 5 o'clock, by Eric Stuart Bruce, M.A., on "Navigation of the Air."

Special tickets are required for these lectures, which can be obtained on application to the Secretary. A sufficient number of tickets to fill the room will be issued to members in the order in which applications are received, and the issue will then be discontinued. Subject to these conditions each member is entitled to a ticket admitting two children and an adult. The supply is now nearly exhausted, so members requiring tickets should apply at once.

Proceedings of the Society.

CANTOR LECTURES.

THE MINING OF NON-METALLIC MINERALS.

By Bennett H. Brough.

Lecture I.—Delivered November 23rd, 1903.

Coals and Bitumens.—Graphite—Coal—Brown Coal —Peat—Petroleum—Ozokerite—Asphalt.

Three years ago I had the honour of giving a course of Cantor Lectures* on the nature and yield of metalliferous deposits, in which I reviewed the sources from which the world's supply of metals are obtained, and attempted to forecast the alterations which might be expected in the near future. It has been suggested that a similar course of lectures dealing with the supplies of the non-metallic minerals of economic importance would be of interest. The subject is undoubtedly one of great importance from a commercial point of view, as will be evident from a moment's consideration of the enormous value of the resources of non-metallic minerals. In the United Kingdom alone the value of the non-metallic minerals raised in 1901 was £111,000,000, while in the United States it was £113,000,000. In both cases it was considerably greater than the value of the metallic products. Moreover, with the advancement of science and technology, attention is constantly being devoted to new raw materials. Thus pitch-blende, the only mineral in which uranium occurs in appreciable quantities, serves for the production of a yellowish-green fluorescent glass, and is now eagerly sought for as the source of radium. Monazite, a silicate containing rare earths, was merely a scientific curiosity, until Auer von Welsbach introduced the incandescent mantle for gas lighting. Calcite is now required for the polarisation apparatus for the sugar industry, mica in the electric industry, magnesite for lining open-hearth steel furnaces, china clay in paper manufacture, and phosphates as fluxes in iron smelting with the object of obtaining highly phosphatic slags for use in agriculture. These are a few examples of the constantly increasing field of usefulness for non-metallic minerals. The most important of all these are the combustible minerals, the coals and bitumens, with which I propose to deal this evening.

I.—The Coal Series.

In the coal series are included a variety of hydro-carbons varying widely in properties. All have originated from the decomposition of plant growth in earlier geological periods. Peat is still in course of formation at the present time. The elementary composition of all these substances is much the same, and the gradual passage of woody tissue into graphite is shown by the following analytical results :—

	Carbon.	Hydrogen	Oxygen.
Wood	100	12·18	83·07
Peat	100	9·85	55·67
Lignite	100	8·37	42·42
Coal	100	6·12	21·23
Anthracite	100	2·84	1·74
Graphite	100	—	—

* *Journal of the Society of Arts*, vol. 48, pp. 673, 680, 705, 712.

Graphite.—Graphite, plumbago, or black lead, as it is variously termed, is regarded by many authorities as the final product of the alteration of plant remains. It occurs chiefly intercalated in the older crystalline metamorphic rocks, rarely sufficiently pure for it to be economically worked. The world's production of graphite in 1900 was as follows:—

	Metric tons.	Per cent. of total.
Austria	29,991	38·0
Ceylon	22,707	28·9
Italy	10,313	13·1
Germany	4,435	5·6
United States	3,000	3·8
Mexico	2,561	3·2
India	2,530	3·2
Sweden	1,783	2·2
Canada	1,307	1·7
Japan	94	0·2
World's total	78,721	100·0

The value of the world's production is estimated at £650,000.

The two principal centres of production are Austria, more particularly Southern Bohemia for the poorer grades, and Ceylon for the coarse-grained best variety. Most of the Ceylon graphite contains more than 90 per cent. of carbon, whilst not more than a quarter of the Austrian output reaches that degree of purity. Of the districts of subordinate importance Piedmont in Italy and Passau in Bavaria are the most productive. The celebrated Borrowdale mines in Cumberland and the Alibert mine in Siberia have long ceased to be productive. In America, the chief deposits of commercial value are in the State of New York. At Hague, Warren County, New York, the bed of graphite (Fig. 1) is nine feet thick and is formed of alternating layers of highly graphitic sandy shale and schist.

Fig. 1.

Graphite Mine near Hague, New York. (C. D. Walcott.)

The purest varieties of graphite are used in the manufacture of pencils and as lubricants; the crystalline (Ceylon, Passau, Scandinavia) for crucibles, stove blacking, paints, and foundry facings. Artificial graphite now enters into competition with the natural product. The manufacture of artificial graphite, started at Niagara Falls a few years ago, continues to increase in importance. In 1901 there were made 1,125 tons, valued at £2 a ton. Half this output was used for the manufacture of electrodes.

Coal.—The word coal is a popular rather than a scientific term, being applied not only to beds of fossilised vegetation, but to any mineral substance capable of being used as fuel. The world's production of the various varieties of coal in 1901 exceeded 789,000,000 tons. It is difficult to realise what this vast amount means. Imagine it placed in 10-ton waggons along a railway line; the train would be 426,000 miles long. It would have to go seventeen times round the equator in order to hold a year's production of coal. The production of the various countries in 1901 was as follows:—

	Metric tons.	Per cent. of total.
United States	266,151,103	33·8
United Kingdom	222,562,123	28·2
Germany	153,019,414	19·4
Austria Hungary	40,757,895	5·1
France	32,325,302	4·0
Belgium	23,462,817	2·9
Russia	16,151,557	2·3
Japan	7,429,457	0·9
Australia	7,000,227	0·9
India	6,742,214	0·8
Canada	5,612,108	0·6
Spain	2,747,724	0·4
New Zealand	1,247,339	0·1
Other Countries	3,919,196	0·6
World's Total	789,128,476	100·0

The outputs of the United States, the United Kingdom, and Germany combined, make up 81·4 per cent. of the world's production. The figures given include anthracite, bituminous coal, and brown coal. In 1902, the United States produced 268,688,000 tons, the United

Kingdom, 227,095,000 tons, and Germany, 107,436,000 tons. The production per head of population in the three countries was three and one-third tons, five and a-half tons, and two tons respectively.

Anthracite.—Anthracite is regarded as a coal, from which all the gas has been removed. It is hard, brittle, and lustrous, and burns with little flame and no smoke. Like other coals it occurs in beds usually of carboniferous age. The principal anthracite regions are in Eastern Pennsylvania and in South Wales, to the west of the Vale of Neath. The present annual output of these two regions is 50,000,000 and 2,000,000 tons respectively.

Bituminous Coal.—This term, a misleading one, is applied to coal which burns with a more or less smoky flame, and chemically occupies a place between brown coal and anthracite. "Flaming" was suggested by Percy as a good substitute for the word bituminous. For economic purposes he classed bituminous coals as (1) non-caking or free-burning, rich in oxygen, (2) caking, and (3) non-caking, rich in carbon. Gruner's researches led to the following classification:—

	Composition.			Coke yield per cent.	Sp. gr.
	Carbon.	Hydrogen.	O + N.		
1. Dry coal burning with long flame ..	75–80	4·5–5·5	15–19·5	50–60	1·25
2. Caking coal burning with long flame (gas coals)	80–85	5–5·8	10–14·2	60–68	1·28–1·3
3. Caking coal proper (furnace coal) ..	85–89	5–5·5	5·5–11	68–74	1·30
4. Caking coal burning with short flame (coking coal)	88–91	4·5–5·5	5·5–6·5	74–82	1·3–1·35
5. Lean or sandy coal burning with short flame	90–93	4–4·5	3–5·5	82–90	1·35–1·4
6. Anthracitic	93–95	2–4	3	over 90	1·6

The passage from one class to another is gradual. The ash-forming constituents of coal vary from 0·5 to 30 per cent. Cannel coal is a variety of bituminous coal, rich in hydrogen, especially valuable as a gas coal. Coal is mined in the United Kingdom from beds of carboniferous age. The seams worked vary from 11 inches up to 30 feet in thickness. The great coal counties are Durham, Yorkshire, and Glamorganshire. Information regarding the occurrence of coal in Great Britain is given in E. Hull's "Coalfields of Great Britain." In the United States the most important coalfields are those contained in the Appalachian mountain system, which extends from Pennsylvania and Ohio, to Alabama. This field furnishes 66·7 per cent. of the total production of the United States. Next in importance are the portions of Illinois, Indiana, and Kentucky, which make up the central coalfield. This contributed 16·6 per cent. of the total output. The western coalfield furnished 8·7 per cent, the Rocky Mountain, 6·2 per cent., and the Pacific Coast, 1·2 per cent. In Germany, the Rhenish-Westphalian coalfield is the most extensive, whilst the largest in Europe is the Donetz coalfield in Russia.

The future of British coal mining is a matter for serious consideration. In 1840, Great Britain produced 75 per cent. of the world's supply of coal; at the present time it produces only 28 per cent. The condition of the iron trade has always exercised a most important influence on the production of coal, so that a large demand for iron draws with it a large demand for mineral fuel. Statistics show, however, that since 1870 the world's production of pig iron has increased from 12,000,000 to 44,000,000 tons in 1902, but the share of Great Britain has fallen from 48·8 per cent. to 20 per cent. It cannot be denied that during the past quarter of a century its coal-mining industry has not developed so rapidly as that of its American and German commercial rivals. Great Britain, until 1899, held the first place.

It is interesting to note that, although coal was first mined as far back as the year 1113, by the monks of the Klosterrath Abbey at Kirchrath on the Wurm, it was in Great Britain that it was first used on a large scale, on the Tyne, the "coaly Tine" of Milton. In 1239, King Henry III. is said to have granted a charter to the townsmen of Newcastle-on-Tyne, for the raising of coal for fuel, and so early was their produce attracted to London, that by the beginning of the next century great complaint arose of the injury done by the coal

smoke to the health of the citizens. "The nice dames of London," says Stow, in 1598, "would not come into any house or room where sea-coals were burned." By the time of Charles I, the use of coal had become very general, and as the demand increased the price went up. In 1643, a pamphlet was published with the imprint "Printed in the year that sea-coal was exceeding dear." At the beginning of the 19th century, about 10,000,000 tons were raised annually in Great Britain. The continental production at that time was very small, the large expanse of forest land having delayed the necessity for turning to mineral fuel. Since then enormous strides have been made. At that period the machinery was of a primitive type. Even in 1837 a colliery was in operation in the county of Durham at which coals were raised by a donkey and banked out and sold by an old woman. Compare this with a modern pit raising 2,000 tons a day from a depth of a quarter of a mile. At Bolsover colliery 3,217 tons have been raised from a depth of 1,175 feet in nine hours, and a week's record at the Cambrian colliery, Clydach Vale, was 13,019 tons, raised from a depth of 1,350 feet. The literature of coal mining is so extensive that it is unnecessary here to enter into details of the remarkable improvement in the mechanical appliances used at collieries. Illustrations will be found in abundance in the standard work by Mr. Herbert W. Hughes, who gives some remarkable photographs taken by himself underground, showing the methods of mining in the 10-yard coal of South Staffordshire. Some very striking examples of machinery were shown in the mining building at Düsseldorf Exhibition last year. Among these must be mentioned the colossal winding engine built by the Prince Rudolph Ironworks at Dülmen for the Preussen colliery of the Harpener Company. It is a vertical 800 horse-power engine, designed by Tomson, to wind from a depth of 4,000 feet, and has two conical spiral drums 32 feet in greatest diameter and 11¼ feet wide. The drums are not, as is the usual practice, placed side by side, but one behind the other, an arrangement that increases the safety and lessens the wear of the rope. Whilst for this engine, which created amazement by its vast size, steam was used as motive power, there was in the same building an electrically driven winding engine, made by the Friedrich Wilhelm works, of Mülheim, which showed that electric driving may now be applied with advantage on a large scale. This engine, built for the Gelsenkirchen Company, raises 1,000 tons in six hours from a depth of 1,650 feet. The two electromotors are each of 1,400 horse-power. The absence of a winding drum is due to the fact that the Koepe system of winding with only one rope is employed. An interesting model showed the winding and coal-washing plant of the Emscher shaft of the Kölner Company. There was also shown a Riedler express pump with double acting plungers of 7¼ inch diameter and 9·8 inch stroke, making 200 revolutions per minute, and raising in that time 550 gallons of water from a depth of 1,970 feet. It was driven by an alternating motor made by the Helios Electricity Company of Cologne.

With the rapid rate of consumption, anxiety as to the duration of the British coalfields is well founded. Professor Hull estimates that the total quantity of coal within a depth of 4,000 feet still remaining is 81,683,000,000 tons. This estimate is reassuring, although it is not in accord with the less optimistic and divergent views on the question expressed by Professor Stanley Jevons, by the Right Honourable Leonard H. Courtney, by Mr. R. Price-Williams, by Mr. T. Forster Brown,* and by Lieut. C. W. Bellairs.† All these estimates are of slight value, owing to the impossibility of prophesying either the rate of increase in production and consumption, or the limits at which mining may be carried on with profit. Early in the last century, a shaft 100 feet in depth was an object of wonder, and a glance over the history of the depths hitherto attained, clearly shows the remarkably rapid progress that has been made in this respect. At the present time the greatest depth at which mining operations are carried on in Great Britain has been reached at the Pendleton colliery, near Manchester, where the deepest workings are nearly 3,500 feet below the surface. This enormous depth has, however, been exceeded in other countries, notably in the Lake Superior district, where the Red Jacket shaft of the Calumet and Hecla copper mine has now attained the record depth of 4,900 feet, and in Belgium, where a colliery at Mons is 3,937 feet deep.‡ Depths such as these show that the limit of depth of 4,000 feet adopted by Professor Hull and by the Royal Coal Commissioners in 1870, though ridiculed at the time, was well within the

* *Journal of the Society of Arts*, vol. 47, p. 506.

† *Ibid*, vol. 49, p. 549.

‡ "Mining at Great Depths." By Bennett H. Brough. *Journal of the Society of Arts*, vol. 45, p. 57.

bounds of possibility. In view of the marvellous efficiency of modern winding engines, no considerations of a mechanical nature need limit the prospective depths of shafts. By far the most important obstacle to very deep mining is the certain and proportionate increase of temperature according to depth. At the Paruschowitz borehole, in Silesia, the deepest in the world, put down by the Prussian Government to a depth of 6,573 feet, this increase of temperature with depth has been found to be 1° Fahrenheit for 62·1 feet. Taking this as a fair average, a coal seam at a depth of 4,000 feet would be, without the cooling action of an artificial ventilating current, 64° warmer than ground near the surface. Further information on these questions may be expected from the labours of the Royal Commission appointed, with terms of reference of a far-reaching character, on December 28, 1901. On August 5, 1903, they issued an interim report, offering no opinion nor recommendation, but containing much valuable evidence.

The questions of the possible economies in the use of coal and of the adoption of better methods of working should prove the most fruitful field for the labours of the Commission. In Great Britain more and more attention is being devoted to improvements in details of mining. Although the use of mechanical coal cutters has by no means become as general as it has in the United States, where 25 per cent. of the output is thus obtained, there has recently been a distinct increase in the use of these labour-saving appliances. Moreover, endeavours are being made to economise in the consumption of coal, notably in the South Staffordshire coalfield, where the producer-gas invented by Dr. Ludwig Mond, has recently been introduced as a cheap source of heat and power. That great economies in the home consumption of coal have been effected since 1871 is unquestionable. Indeed, Mr. Price-Williams has shown that, whereas in 1871 the iron and steel trade required 30 per cent. of the coal consumed in the United Kingdom, its requirements had been reduced to 16 per cent. at the time he read his paper before the Statistical Society in 1889. With improvements conducive to economy in fuel it is evident that a considerable industrial development may take place with a very slight increase in coal consumption.

From time to time important new discoveries of coal are made in various parts of the world. Coal, for example, has now been struck at Dover in the area described by Mr. W. Whitaker.* In Belgium again, in that portion of the province of Antwerp known as the Campine, coal of excellent quality has recently been found, and it is estimated that this new field contains more than 500,000,000 tons of coal. In the British colonies and dependencies the production of coal increases year by year. In the eastern states of Australia there are some 62,000 square miles of coal-bearing country, and the coal resources of India have been shown by Professor W. R. Dunstan† to be enormous. There can, therefore, be no doubt that there are ample resources to meet all the demands for coal. Nevertheless, with a view to husbanding the British coal resources, the need for taking measures to avoid waste in mining is apparent. The great waste of small coal, though lessening year by year, is still a reprehensible extravagance. The more general use of coal-mining machines would tend to reduce this source of waste by furnishing a larger proportion of lump coal. There is, too, much needless waste in the consumption of coal, notably in the coal used for domestic purposes. Saving in this direction might give the country years of prosperity.

Brown Coal.—Under the general term of lignite or brown coal, Percy included those varieties of coal that form the intermediate stage between peat and true coals of carboniferous age. According to their geological age, brown coals have a distinct ligneous texture (true lignite, fibrous brown coal), or are without organic structure (earthy brown coal), or black and lustrous with conchoidal fracture. Brown coal burns with a very long smoky flame. It is largely used for heating steam boilers, evaporating pans, and for domestic purposes. The better qualities are sometimes used in Austria and Germany for metallurgical purposes. In Great Britain, brown coal has been worked only in a seam of lower tertiary age at Bovey Tracey in Devonshire. On the Continent, brown coal is extensively mined, the greatest production being shown by North-West Bohemia and the district of Halle in Prussia. In 1902, Bohemia with 36,074 miners raised 18,262,592 tons of brown coal, whilst the Halle district with 35,055 miners raised 29,233,936 tons in 1902. Besides this, the mines of the Cologne district raised 5,354,440 tons, the kingdom of Saxony, 1,635,000 tons, Upper Bavaria, 24,000 tons, and Styria in Austria, 2,585,233 tons. The beds of brown

* *Journal of the Society of Arts*, vol. 38, p. 543.

† *Ibid*, vol. 50, p. 371.

coal often attain considerable thickness, six to eight yards being not unusual. At Brühl, near Cologne, the brown-coal bed is in places as much as 340 feet thick. Most of the brown coal from this bed is compressed into briquettes for household use, the development of the industry having been greatly facilitated by the fact that the Rhine is available for transport. The proprietors of one of the mines in this district have had the enterprise to add to their equipment an electric central station, which by means of 50 miles of main cables, furnishes a large area with light and power. The brown coal, which is mined in open workings, is taken by electric haulage to seven boilers, the steam being used for engines that drive triphase generators yielding currents at 5,700 volts. Thick deposits of brown coal are found at various localities in the British colonies. At Lal Lal, in Victoria, for example, the beds are 150 feet thick, and are covered by basalt. At the Miranda Mine in New Zealand the seam is 55 feet thick.

Peat.—Peat or turf is the most recent product of the decay of plants under special conditions of air and moisture, either in swampy ground, actually under water, or in mountainous regions kept moist by fogs. It consists of the fossil remains of moss mixed with other plants. It may be classified (1) according to the localities where it has been formed as lowland and mountain peat; (2) according to its age, as recent peat with distinct vegetable structure, and old peat of a dark brown or black colour, with mere traces of organic texture; (3) according to the mode in which it has been extracted, as cut peat or dredge peat. Peat bogs are of frequent occurrence in all parts of the world. In Europe, the most considerable are in Russia, Ireland, Germany, Scandinavia, and Austria. In France, Italy, and Spain, peat is of less frequent occurrence. Air-dried peat is used for heating boilers, evaporating pans, pottery kilns, and for domestic purposes. Even when dried, peat cannot be economically substituted for coal on account of its bulky nature and consequent cost for carriage, its want of uniformity, and its large percentage of water and ash. Many well-directed efforts have been made of late years to utilise the material in the very extensive peat bogs of Ireland, Scandinavia, and elsewhere, by producing by compression or other treatment, a compact and useful fuel; and there can be no doubt that compressed peat will be more generally used when the cost of coal is much enhanced.

II.—The Bitumen Series.

Besides coal, there are a series of hydrocarbons occurring in various forms: as natural gas, liquid as petroleum, viscous as ozokerite, and solid as asphalt. There are too, gradations from one to another. Whilst coals appear to have been formed from the decomposition of plants, the bitumens are probably distillation products from organic matter of animal origin.

Natural Gas.—This subject has already been dealt with in papers by Prof. J. Dewar* and Mr. W. Topley†. In the petroleum districts of Pennsylvania and adjoining States, natural gas issues from the strata at a depth of 500 to 2,000 feet below the surface, and when boreholes are sunk to the accumulation, the gas rises under a mean pressure of 150 to 200 lbs. per square inch. When first reached, the tension of the gas is very high, 1,000 lbs. per square inch being not unusual. Since 1821, natural gas has been utilised in a limited way; but since the reading of Mr. Andrew Carnegie's paper on natural gas before the Iron and Steel Institute in 1885, it has attained an extraordinarily rapid development for industrial purposes. For generating steam, 1,000 cubic feet of gas is equal to 80 to 133 lbs. of coal. The neighbourhood of Pittsburg, in Pennsylvania, is the most important locality for natural gas. No record is kept of the production in the United States. The amount of coal, however, displaced by gas in 1901 was 8,458,600 tons. There were 10,297 wells producing, and there were 21,848 miles of natural gas mains, the gas being used in 1,545 industrial establishments. It has been found that the supply of gas in a reservoir is limited. Indeed, some have already been exhausted. On the other hand, a gas well in Ohio has been blowing for twenty years without any apparent diminution in the supply. Natural gas is also being produced on a commercial scale in England by the Natural Gas Fields of England, Limited (capital £100,000). It was discovered in west Sussex as long ago as 1836, and later discoveries induced the London, Brighton, and South Coast Railway Company to light Heathfield Station with natural gas. Bore holes were then sunk 300 to 400 feet through impervious sandstone and marl with successful results, and at Heathfield some 80 houses are now using natural gas for lighting and heating. It is burnt in the street lamps, and gas-engines are being driven by it. According to the

* *Journal of the Society of Arts*, vol. 33, p. 771.

† *Ibid*, vol. 39, p. 421.

official statistics compiled for the Home Office by Sir C. Le Neve Foster the production of natural gas in 1902 was 150,000 cubic feet. Experimental borings are being made over 200 square miles of the county of Sussex, and if it can be proved that the Weald is underlain by a gasfield the industrial conditions of the south of England will be entirely changed.

Petroleum.—The subject of petroleum has already been exhaustively dealt with in a course of Cantor Lectures by Mr. Boverton Redwood,* and has since been discussed in papers read before the Society by Mr. R. D. Oldham,† Mr. G. Stockfleth,‡ and Sir Marcus Samuel.§ I need, therefore, deal but briefly with this industry which during the past 40 years has acquired such remarkable importance. It dates from the year 1859, when Colonel Edwin L. Drake bored at Titusville, Pennsylvania, the first oil well. The utilisation of the distillates of the crude oil, benzine and petroleum, and the heavy oils as residues, soon not only acquired important development in the United States, but furnished an important article of export. The still more important petroleum field of Baku, on the eastern side of the Caucasus on the Caspian Sea, where the occurrence of petroleum was described by Marco Polo in the 13th century, and where the existence of the eternal fires of the Apsheron peninsula has been known for 2,500 years, has been developed since 1870. The importance of the petroleum industry is best shown by the fact that some 20,000,000 tons are produced annually; of this the United States and Baku produce the bulk, Galicia, Roumania, Burma, the Dutch Indies, Japan, and Canada comparatively small quantities. The world's production of petroleum in 1901, was as follows:—

	Metric tons.	Per cent. of total.
Russia	9,827,822	49·2
United States	8,811,326	44·2
Austria-Hungary	407,958	2·0
Roumania	320,000	1·6
India	201,135	1·0
Dutch Indies	128,604	0·6
Japan	86,200	0·4
Canada	74,383	0·3
Germany	44,095	0·2
World's total	19,940,447	100·0

* *Journal of the Society of Arts*, vol. 34, pp. 805, 817, 830, 867, 883, 899, 915.

† *Ibid*, vol. 42, p. 145.

‡ *Ibid*, vol. 42, p. 616.

§ *Ibid*, vol. 47, p. 384.

The residues, known in Russia as Mazout, compete in the oilfields with coal. They serve for heating locomotives and steam ships. The transport of the oil is noteworthy. For retail trade it is loaded in the well-known blue barrels or in rectangular tinplate cases. For transport on a large scale, tank steamers are used, and tank waggons on the railways, the loading and unloading being effected by pumping in pipe lines. Certainly, Drake's enterprise in 1859 marked an epoch in the history of mining. Compare the carriage of oil in barrels on waggons and in flat boats down the creek to the river, with the pipe-line transportation from the wells to the coast. Compare, too, the £4 a barrel paid for Drake's crude oil with the 4s. a barrel at the end of the century.

Being cheap and developing great heat on combustion, petroleum is largely used as fuel. The average calorific power of the crude oil is 10,000 calories. Various varieties give the following calorific powers, in calories:—West Virginia, heavy oil, 10,180; West Virginia, light oil, 10,223; Pennsylvania, light oil, 9,963; Ohio, heavy oil, 10,399; Java, 10,831; Roumania, 10,005; and Baku, 11,460. The recent development of the Texas oil fields has resulted in a great increase in the number of steamers, locomotives, and factories using oil fuel in the United States, whilst in South America, Peruvian oil has been largely used. The Borneo, Japan, and Sumatra oilfields are supplying large quantities for consumption in India, Japan, and Australia. No oil is so suitable for illumination as that of Pennsylvania. In many circumstances petroleum is a very economical fuel. It occupies less space than coal, a ton of coal occupying 40½ cubic feet, oil 33 cubic feet. It also presents the advantages of greater efficiency of evaportion per unit measure of heating surface, more equable generation of steam, greater cleanliness and freedom from ash, avoidance of heat caused by frequent opening of furnace doors, and instantaneous extinction of furnace fires.

The Russian supplies are the most extensive, the chief district being to the north of Baku on the Caspian. At the present time some 2,000 boring derricks are in operation, and during 1902 they raised 11,000,000 tons of crude petroleum. The bore-holes have an average depth of 200 yards, some being as much as 500 yards. The derricks are 30 to 60 feet high. As motive power for boring and pumping from the wells, steam is usually employed. In 1898 a company was formed to erect a central electric station of 1,500 horse-

power in order to use electro-motors instead of steam-engines. Each of the derricks is furnished with a motor which is used for boring and subsequently for winding up the oil. It sometimes happens that when oil is struck, the petroleum, after demolishing the derrick, spouts up as a fountain (Fig. 2). A difficulty in the way of installing alternating current motors, is the risk of fire, for, unfortunately, conflagrations are frequent and extensive. In the spring of 1902, for example, more than 100 derricks were burned. Disastrous fires, due to incendiarism, have

FIG. 2.

PETROLEUM FOUNTAIN AT BAKU.

also occurred quite recently. The electromotors are consequently placed on a solid masonry foundation, and in a separate brick building (Fig. 3.) The motor is thus kept away from the derrick, which is specially in danger of fire.* The production of oil is largely in the hands of Nobel Brothers, and of the Rothschilds. Of late years, however, a large amount of British capital has been invested in these undertakings, the chief companies being the Russian Petroleum and Liquid Fuel Company, Ltd. (capital £1,200,000); the Baku Russian Petroleum Company, Ltd. (capital £1,500,000); the Schibaieff Petroleum Company, Ltd. (capital £1,150,000); the European Petroleum Company, Ltd. (capital £1,100,000); and the Spies Petroleum Company, Ltd. (capital £700,000). British capital is also being invested in the Chatma oil field, a promising field almost midway between Batoum and Baku.

* According to Mr. L. Gaster, experience in the Roumanian oilfields tends to show that the polyphase motor is the best for boring and pumping, and, if properly enclosed, can be brought quite near to the well without danger.

Although no petroleum is raised in Great Britain, oil shale is in Scotland the basis of a considerable industry. The county of Linlithgow yields more than half the production. The mineral occurs in beds in sandstone at the base of the carboniferous strata. Similar deposits are mined at Autun and Buxières-la-Grue in France, and in New South Wales. In 1901 the production of oil shale in Scotland

FIG. 3.

ELECTROMOTOR HOUSE AT BAKU OIL-WELLS.

was 2,354,356 tons, and of kerosene shale in New South Wales 54,774 tons. The oil shale mines of Scotland yield a product of greater money value than the tin mines of Cornwall.

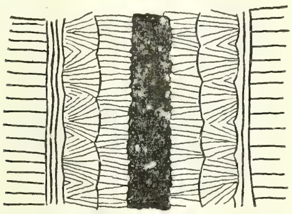
Ozokerite.—In 1883 this mineral-wax formed the subject of a course of Cantor lectures by Mr. L. Field,* who described the properties of the mineral and its use in the manufacture of candles. The most important deposit of ozokerite mined is at Boryslaw, in Galicia. As long ago as 1856 petroleum was obtained in this district from shallow wells. The mineral-wax was known, but it was not until 1862 that it was raised and purified. It fills fissures in Miocene shale and sandstones forming a kind of network. Serious gas explosions are not uncommon. The output of ozokerite in Galicia in 1901 was 2,707 tons. Mining

* *Journal of the Society of Arts*, vol. 31, pp. 821, 833, 846, 857, 869, 881.

there was conducted in an extremely primitive manner until September 16, 1897, when a law was passed which required the shafts to be at least 60 yards apart and provided with adequate machinery for ventilation. The industry has, in fact, been placed on so satisfactory a basis that a great future is in store for it. The present selling price of ozokerite is 9d. per lb., or £84 per ton.

Asphalt. — The term asphalt is usually applied to limestone impregnated with pure bitumen. The latter is sometimes met with in veins, as at Bentheim, in the province of Hanover, where veins (Fig. 4) three feet wide occur in shale of cretaceous age, the veins containing black asphaltum, clayey asphalt, radiated iron pyrites, and calc-spar. In New

FIG. 4.



ASPHALT VEIN, BENTHEIM.
(Heinrich Credner.)

a, Gault shale; *b*, clayey asphalt; *c*, radiated iron pyrites; *d*, calcspar; *e*, pure asphalt.

Brunswick veins of asphalt, known as albertite, occur in bituminous schists and are mined on a large scale. Very pure asphalt is also obtained from the Dead Sea. This material, which is not worked at present, was doubtless used in ancient times as water-tight cement in buildings. It was used by the ancient Egyptians for embalming their dead, and it is remarkable that there is no record of its use throughout the middle ages, up to the 18th century. A celebrated deposit that has been worked for a century, is the Pitch Lake of Trinidad. The lake is a mile and a-half inland from Brea. It is very irregular in shape, and about a mile in length. It is of unknown depth, and solid enough to be walked over. The pitch is hacked out by picks. Wherever it is abandoned for a few days, the cavity fills up from below. In one part of the lake the pitch is hot and plastic, and this soft spot is continually changing. Plant for dealing with the pitch on a large scale has been erected by the New Trinidad Lake Asphalt Company. Mr. J. W. Gordon and Professor Henry Louis consider that at the present rate of extraction of about 120,000 tons per annum from the Pitch Lake, the deposit should still last for more than a century. In Barbados, manjak (mineral pitch) occurs in veins in infusorial earth.

The mining of asphalt rock has rapidly developed since the first asphalt pavement was laid down in Paris in 1838. The oldest mines are those of Seyssel, near Bellegarde on the Rhone, and of the Val de Travers in the Swiss Canton of Neuenberg. The asphalt rock of the Val de Travers is a bituminous limestone of cretaceous age. The bed is 12 to 24 feet in thickness, and contains 10 per cent. of bitumen. At the present time the mines of Ragusa, in the island of Sicily, are the most important, the production having increased from 4,000 tons in 1879, to 79,000 tons in 1901. The asphalt occurs in Miocene limestone, and contains 10 to 18 per cent. of bitumen. The product is very similar to those of Seyssel and Val de Travers, so that it can be mixed with them without lessening the binding properties. The output of the other mines in Europe (Seyssel, Val de Travers, Chieti in the Abruzzi, Limmer and Vorwohle in Hanover, Lobsann in Alsace, Auvergne, and Syzrane in Russia), may be estimated at 120,000 tons annually. In the United States asphalt is mined chiefly in Utah and California. The world's production is about 600,000 tons annually, the principal producing countries having raised in 1901 the following amounts:—

	Metric tons.
France	285,000
Trinidad	129,797
Italy	104,111
Germany	90,193
United States	57,290
Spain	3,956
Barbados	1,044

Particulars of the production of Switzerland are not available. Small quantities are also produced in Russia, Mexico, Turkey in Asia, Colombia, Canada, and Holland. The average price of crude asphalt at Ragusa is 13s. per ton. Several English companies are engaged in asphalt mining. The Val de Travers Asphalt Paving Company, Ltd. (capital £100,000), registered in 1871, made in 1902 a trading profit of £42,256. The Limmer Asphalt Paving Company, Ltd. (capital £40,000), also registered in 1871, paid in 1901 a dividend of 10 per cent. and a bonus of 10 per cent. The Neuchâtel Asphalt Company, Ltd. (capital £569,880), paid in 1901 a dividend of 14s.

per £10 share. The United Limmer and Vorwohle Rock Asphalt Company, Ltd. (capital £60,000), paid for each of the 12 years up to 1901 a dividend of 10 per cent. and a bonus of 2½ per cent.

Within the last few years asphalt deposits of considerable extent have been opened up in the Indian territory, United States. At Tar Springs the deposit occurs in a basin about a mile in diameter, the asphalt being met with in sand and sandstone which it has thoroughly impregnated. The overburden is removed and a thin capping of barren sandstone blasted off. The bed is then loosened by ploughs drawn by teams of four or six mules and excavated by wheeled scrapers. The sands contain 10 to 14 per cent. of asphalt, and three to six per cent. of heavy oil. The asphalt sands are tipped and shovelled to a feed bin, and conveyed thence to a disintegrator, which is heated by steam to facilitate the passage of the adhesive asphaltic material. The broken-up material is raised by an elevator to the concentrating apparatus in the upper part of the building. The concentration is based on the fact that the associated heavy oil adheres to the asphalt and buoys it up, while the sands, freed from both asphalt and oil, and washed by warm water, are discharged by an underconveyor. The asphalt and oil rise to the surface of the water, and are discharged by the upper conveyor. This method of separation was devised by Mr. R. V. La Grand, and is similar to the Elmore oil process of concentrating ores. The elimination of water and oil from the asphalt is effected by evaporation. The total loss in concentrating and refining, varies from four to six per cent. The refinery cost £8,000. The cost of mining is 4d. per cubic yard, and that of refining, about £2 per ton. The plant is designed for a capacity of 25 tons finished product per day of 24 hours.

Correspondence.

INDIA'S PLACE IN AN IMPERIAL FEDERATION.

During the debate on Mr. J. M. Maclean's paper, it was noticeable that none of the speakers stated the factors to be dealt with in any readjustment of Indian Customs duties—the *corpus* on which the inquest was being held. Mr. Maclean did say that the figure of our whole trade with India (or, including that with Ceylon and the Straits, these two pertaining to the Colonial category) is more than with all our Colonies put together. And the Chairman mentioned two or three round totals; but these passing references left the financial facts of the case quite vague. So those were not enough. There are only three main factors to be handled; or six when exports and imports are set out, as would be needful before any distinct opinions can be formed. These are here stated in concise compass, thus:—

India's Seaborne Merchandise Trade, Year 1901-2.

Imports.

From British India into—	£
United Kingdom	20,247,023
British Possessions	17,594,421
Foreign Countries	43,593,639

Exports.

To British India from—	£
United Kingdom	35,037,509
British Possessions	5,017,454
Foreign Countries	14,258,316

As to the forms and terms of this Table, two explanatory remarks may be needed: (*a*) the amounts are given in the recently adopted Dawkin's pounds (not true sterling, counted at fifteen rupees) as being more tangible for English readers, the several proportions serving as basis for comparison of each of the six factors; (*b*) Treasure is, of course, omitted on both sides, though that large factor would be essential in any estimate of India's full commercial balance sheet; but no one proposes to give preference to or penalise movements of specie in or out of India, more than by the present five per cent. imposed on imports of silver—other than those on State accounts for coinage purposes. So it will appear that the only factor to be dealt with in any scheme of differential duties is the 14¼ millions of foreign imports into British India, for it is not conceivable to tax exports from India. However, as a certain prominent authority has remarked, "Figures are only illustrations . . . the proof will be found in the argument:' and, as the arguments were fairly well surveyed by the experienced debaters on the 10th, these statistics, as above, will complete the subject matter.

W. Martin Wood.

[Letters have been received from Sir Guilford Molesworth, Mr. M. E. J. Gheury, and Mr. H. H. Cunynghame, which will be printed in the next number.]

Volume LII. of the Journal.—By an unfortunate oversight the numbers of the *Journal* 2662, Nov. 27; 2663, Dec. 4; 2664, Dec. 11; and 2665, Dec. 18, have had "Vol. LI." printed at the head of the first page of reading matter instead of "Vol. LII." The correct number of the Volume is given on the cover of the *Journals*.

Journal of the Society of Arts.

No. 2,667. Vol. LII.

FRIDAY, JANUARY 1, 1904.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

NEXT WEEK.

Wednesday Afternoon, January 6, 1904, 5 p.m. (Juvenile Lectures.) Eric Stuart Bruce, M.A., "Navigation of the Air." (Lecture I.)

Further details of the Society's meetings will be found at the end of this number.

JUVENILE LECTURES.

As a sufficient number of tickets for these lectures to fill the room have now been given out, it will not be possible to issue any further tickets.

Members are reminded that special tickets are required for these lectures, and that admission cannot be obtained without a ticket.

Proceedings of the Society.

APPLIED ART SECTION.

Tuesday evening, December 15, 1903, Sir Thomas Wardle in the chair.

The paper read was—

THE BRITISH SILK INDUSTRY.

By Frank Warner.

In dealing with this subject, I have classified my remarks as follows:—

I. A review of the past history of the industry, which, from its somewhat depressing nature, I shall make as brief as possible.

II. Causes of its decline, some of which still operate against its revival.

III. Its present condition and future prospects.

IV. A description of the exhibits.

I.—Past History of the Industry.

The earliest historical notice of silk manufacture in England (says Mr. G. R. Porter in his excellent treatise on the subject, published in "Lardner's Cyclopædia") is contained in an Act of Parliament passed in the year 1363, during the reign of Edward III., to restrict different artificers, merchants, and shopkeepers, to the manufacture of or trading in one particular kind of goods according to their own choice, which they were required to make and declare by a certain day named in the Act, and in which extraordinary restriction especial exception is made in favour of female brewers, bakers, weavers, and spinsters, and other women employed upon works in wool, linen, silk, &c. The fact that silk was mentioned in the articles enumerated in this Act, proves that its manufacture in some form or other was even at this early date in progress in this country, although we have every reason to believe it was restricted to narrow articles, such as ribbons, fringes, trimmings, and embroideries, as we find by a law passed in the year 1454, during the reign of Henry VI., protecting the silk women of London against the importation of these articles. A further Act, in 1463, prohibited the importation of laces, ribbons, silk, fringes, and similar goods, but neither in these Acts, nor in a similar one passed in the reign of Henry VII., do we find any mention of broad silks. From this we naturally conclude that the manufacture of broad silks was of a later period —and its introduction is attributed to the Flemish, who settled in this country in the 16th century, and established an industry of weaving plain and figured silks, which speedily grew to such importance that, in the year 1629, the silk throwsters of London were granted a charter of incorporation.

The establishment of silk manfacture as one of our great national industries dates, however, from the time when the Huguenots were driven out of France by the persecution which followed the revocation, in 1685, of the Edict of Nantes. It is estimated that at least 70,000 Huguenots sought refuge in this country, many of whom had been engaged in the fabrication of silks; and settling first in Canterbury, Norwich, and Spitalfields, they began the manufacture of satins, lustrings, du-capes, velvets, and brocades of the richest and most elaborate

kind, and quickly proved by their skill, industry, and exemplary mode of living that France had heavily lost, and England richly gained by the wickedness and folly of Louis Quatorze and Madame de Maintenon.

In course of time, the industry spread to other towns, such as Sudbury and Braintree, and with the advent of the power loom, important centres of manufacture sprang into existence at Macclesfield, Manchester, Coventry and Dublin. Although not always enjoying uninterrupted prosperity, the trade grew and flourished until it reached the zenith of its power in the period between 1850 and 1860. All statistics point to the fact that at that time a greater number of people were employed in the industry than at any other. At this juncture, it would perhaps be as well to mention the fiscal conditions under which the trade up to this time had been carried on. Until the year 1826, the importation of foreign silk goods was absolutely prohibited, which led, in the absence of any possibility of competition, to indifference on the part of the home producer to the requirements of the trade, and to considerable smuggling of French goods in consequence of their then superior quality. In that year, 1826, the duties on the raw and thrown material were geatly reduced, and foreign silks were allowed to be imported at an *ad valorem* duty of 30 per cent. This was followed in 1846 by a still further reduction to 15 per cent., whilst the duties on thrown and raw silk were removed. This condition of things remained in force until the eventful and fateful year of 1860, when the duty on the manufactured article was entirely abolished, and from that date the decline of the home industry has been both rapid and continuous. Only once since has there been any real revival, and that was in 1870 and 1871, when the Franco-Prussian war paralysed the output of silk goods from those countries, causing an enormous demand for those made here; but the prosperity of those two years was only short-lived, as, with the end of the war, the industry quickly relapsed into its former declining state. Nowhere has the ruin been more complete than in Spitalfields, which now exists, as far as its connection with the silk trade is concerned, in little more than name only; a few hand-loom weavers are still employed, but if I put the total number of workers in silk in Spitalfields to-day at from 300 to 400, I shall have estimated freely. Some of the weavers have migrated to other localities where rents are cheaper and the surroundings cleaner and brighter, but their numbers are few in comparison with the 50,000 people who were at one time, directly and indirectly, engaged in the silk trade, and we must look elsewhere for the causes which have removed from the teeming population of the East End of London, an industry which was not only remunerative, but which from its nature had an elevating and refining influence on those engaged in it.

The great silk town of the north, Macclesfield, is by no means enjoying its once great prosperity, and although now the most important silk-producing centre, it is estimated that the trade has fallen off by nearly 50 per cent., the hand-loom weavers, in particular, suffering severely from lack of employment.

With regard to Coventry, celebrated for its ribbon weaving, the industry has broken down to a far greater extent. In the year 1859, there were between 70 and 80 ribbon manufacturers in Coventry, without counting those in the surrounding districts, employing from 10,000 to 12,000 workpeople, but with the advent of free imports the great bulk of these people were speedily brought to ruin, and in spite of every effort on the part of the manufacturers, both individually and collectively, to adopt the most up-to-date methods and machinery, trade has decreased, until to-day there are not more than 2,000 people employed, and only very few of these are working on ribbons. Unfortunately, the losses in these three best-known centres have not been made good by gains elsewhere. The decline, with but few exceptions, has been general, as the following figures, taken from the Board of Trade Returns, of the number of persons employed in the industry decennially from 1851 to 1901 will show:—

Year.	Males.	Females.	Total.
1851	53,936	76,787	130,723
1861	43,732	72,588	116,320
1871	29,225	53 738	82,963
1881	22,205	42,630	64,835
1891	19,090	32,937	52,027
1901	13,859	25,176	39,035

showing a total falling off in 50 years of 91,688 persons, or about 70 per cent. Still more startling are the figures relating to the dealings in raw silk. The years 1858 to 1860 show an average importation of 8,459,038 lbs. per annum. Compare these figures with the imports of the years 1900 to 1902, averaging only

1,332,883 lbs. per annum, and we realise the astounding fact that in 45 years we have lost no less than 85 per cent of our trade in the raw material. Much of this loss is of course attributable to the falling off in the consumption of raw and thrown silk in our manufactures, partly owing to the decline of the industry and partly to the largely-increasing use of spun and tussah yarns in place of net silk, but the chief cause is to be found in the fact that England long ago ceased to be the great silk market of the world, a position she once held when the productions of the East came to Europe by way of the Cape, but the opening of the Suez Canal in 1869 diverted the traffic, and the silk now arrives at Marseilles and other Mediterranean ports, causing Lyons and Milan to supersede London as the great distributing centre of the world's silk crop.

COMPARATIVE TABLE OF BOARD OF TRADE RETURNS FOR IMPORTS OF RAW, THROWN AND WASTE SILK, AND MANUFACTURED SILK GOODS—1858-60 AND 1900-02.

	1858.	1859.	1860.
Raw.... (lbs.)	6,277,576	9,920,891	9,178,647
*Thrown ,,	358,269	327,462	224,335
Waste..(cwts)	16,765	20,808	17,435
	£	£	£
Goods (value)	2,111,819	2,655,357	3,246,119
	1900.	**1901.**	**1902.**
Raw.... (lbs.)	1,413,320	1,322,480	1,252,848
Thrown & spun	664,641	624,859	802,964
Waste.. (cwts.)	60,720	48,162	55,782
	£	£	£
Goods .. (value)	14,281,250	13,030,321	13,416,400

* There were probably no imports of spun silk at this date

II.—CAUSES OF THE DECLINE, SOME OF WHICH STILL OPERATE AGAINST ITS REVIVAL.

I now have to deal with the causes which have led to the decline of the industry; and although it has been my earnest endeavour to avoid any reference to the burning controversy of Free Trade *versus* Protection, the history of the rise and fall of silk manufacture in this country is so bound up in fiscal matters, that I found it impossible to write this paper without referring to them.

In the first place I am convinced, from a thorough study of my subject, that its decline is chiefly due to the removal, in 1860, of the 15 per cent. duty on foreign goods, which has resulted in the flooding of the home market with the productions of other countries, in all of which, with the exception of America, with whom we have not as yet been brought into serious competition, labour is much cheaper.

2ndly. That the rapidity and extent of its decline was accelerated by the disorganised condition of the home industry, which was ill-fitted to meet the tide of unrestricted foreign competition. In Spitalfields, the weavers, draughtsmen, jacquard machinists, loom-builders, card-cutters, and other mechanics, possessing a knowledge which had been for generations handed down from father to son, and also acquired by the old system of apprenticeship, were both competent and skilful, but the manufacturers, whose duty it was to lead, were, for the most part, technically inefficient, and displayed but little knowledge and taste in design and colour, either natural or acquired. Similar conditions undoubtedly prevailed in other silk centres, there were a few art classes, but no technical schools, no trade organisation, nothing in fact that was required to enable the industry to keep possession of the trade, and it is but small wonder that disaster so rapidly overtook it.

3rdly. That as the home manufacturer gradually lost ground under the stress of foreign competition, financial necessity, in many cases, drove him into the hands of his trade creditors who, by advancing money to temporarily bolster up the business in the hope of better times, gradually obtained such a hold over him, that he became practically compelled to take anything they chose to give him. The result being that the goods deteriorated by the use of unsuitable sizes and qualities of silk. This still further crippled his efforts, and brought him eventually to that ruin from which so few of the old manufacturers have escaped.

Of the causes which still operate against the revival of the industry, undoubtedly the chief one is that which has caused its decline, viz., the unrestricted importation of foreign goods made by cheaper labour.

In Italy, the women and girls employed in silk throwing are paid on an average 60 to 70 centimes a day for winding, cleaning, and doubling the silk. For the actual throwing men are employed, and they are paid piece-work, at the rate of about 5d. per pound for organzine, and about 1½d. per pound for tram, and their average daily earnings for 12 hours' work per day, varies from 2 francs to 2·50 francs. The weavers are paid by piece-work. In a day

of 10 hours' actual work, women can earn from 1 to 2 francs, and the men from 1·50 to 3 francs, according to their individual ability and to the quality of the goods produced, so that the highest rate of earnings by the most skilful man fully employed would only average 12s. to 15s. per week, which is, if anything less than half what a skilled British workman is compelled to earn in order to live in this country. This marked difference in the price of labour is very severely felt in the lower qualities, which constitute the great bulk of silk goods that are used; and it is only by the sacrifice of what should fairly constitute a manufacturer's profit, that the British producer can keep his workpeople employed. But an even more serious drawback to the home manufacturer is the "dumping" of large quantities of foreign goods, which are thrown upon this market, usually at much less than cost price, whenever the foreign manufacturer wishes to dispose of his surplus stock. Against the low-priced labour, the British producer may sometimes regulate his prices so as to secure a sale for his goods, but he is powerless to contend with the paralysing effect of dumping. It is contended by some people that this dumping of foreign goods has its advantages, which is very possible, but I maintain, from a point of view of national welfare, that any advantage accruing to the purchaser of foreign job stocks is grealły outweighed by the injury done to the silkworkers here. Another very great detriment to the home industry is the excessive adulteration of foreign silk goods, which, in order to cheapen the cost of production, are weighted to such an outrageous extent as to bring the use of silk goods into disrepute, the sale of which constitutes nothing more nor less than a fraud upon the public. Before the silk is dyed, the natural gum is discharged from the fibre, by a process called boiling off, in which it loses 25 per cent. of its weight. It has been the practice, even from the earliest times, to replace this loss to some extent by artificial means, as we read that, in the year 1630, King Charles I., by means of a proclamation, restricted the weight of dye beyond a just proportion.

The old methods of weighting were applied chiefly to blacks, colours being comparatively pure, but the modern process of weighting by means of metallic salts, which have a great affinity for silk, has enabled the dyers not only to weight blacks to an enormous extent, but whites and colours can be almost equally adulterated, and it is no uncommon thing for the 12 ounces that are left from a pound of silk after boiling off, to be weighted up to 30 or 40 ounces, or even more. In connection with this fraudulent weighting of silk, the *Lancet*, in its issue of October 17th, remarks as follows:—

"A few days ago, we had occasion to examine a piece of silk, that formed the sleeve of a blouse, which set up an acute irritation of the skin. Analysis disclosed that the material was loaded with no less than 40 per cent. of mineral matter consisting, as further examination showed, of the oxides of aluminium and tin, with distinct traces of arsenic. Thus, nearly half the weightiness of this 'silk' was due to metallic oxides. Is it wonderful that such a material worn next the skin should set up irritation? When is the scandal of substitution—which is but a mild word for fraud—in such cases as we have quoted going to be adequately checked by the State? At present the evil is growing apace, discussion about it soon subsides, and nothing is done. If it be true that English trade is going to the dogs, we think that we can find at least one reason for this decline. To be candid, there is far too much dishonesty about it."

In reply to this statement of the *Lancet* I would remark that whilst unlimited adulteration is allowed in silk goods it is not permitted in woollen or linen materials unless specifically defined, and it seems to me that this is a matter which might well receive the attention of the Silk Association of Great Britain and Ireland, who should, in the interests of the trade, take steps to obtain power to regulate the standard of purity of silk goods in the same way that the Flax Spinners Association, and the Pure Linen Manufacturers Association, look after the interests of their respective trades.

Goods for upholstery purposes should under no circumstances be weighted, but moderate weighting to the extent of what is known as an 18 or 20 oz. for colours for dress fabrics, trimmings, linings, &c., is no drawback, and in the case of blacks is a positive advantage, a better and faster colour being attainable than if no weighting matter be used. I have here as an example a piece of white dress brocade made from absolutely pure unweighted dye, together with another piece exactly similar in appearance made from a 16 oz. warp and a 20 oz. weft, the difference in the cost of production being 25 per cent. in favour of the latter, and it is evident that for dress purposes the cheaper make, whilst equal in appearance and feel to the former, would wear quite as long as is necessary for the rapid changes of fashion in the present day. But the Continental dyer

goes far beyond this, and we find it quite a common thing for goods to be weighted up to 40 oz. for colours, and to more than double that for blacks, which is far greater than the thread can stand with any chance of its wearing, and it is no uncommon thing for a so-called silk blouse, made of such material, to crack and split in all directions after a few days wear. I may be told this is quite long enough for the fleeting fashion of the day, and so limited a time may satisfy the needs of the *nouveaux riches*, but by the ordinary woman whose means are limited, and to whom a silk blouse is not an every day purchase, something more durable is expected, and it is high time that some restrictions, similar to those imposed by Charles I., were placed on this reckless weighting, and as it is difficult at the time of purchase, even for an expert, to decide the extent of adulteration, the vendors of such articles ought to be debarred under severe penalties from selling them as silken fabrics, and I would suggest that those goods adulterated to a greater extent than $33\frac{1}{3}$ per cent., or an 18 ounce dye, should be compelled to have a name, such as "silkette" or "silkeen," which would indicate to the purchaser that they were not buying a genuine article. This defining of the material by a distinctive name, would not in the least affect the sale of cheap and pretty dress materials but it would act as a protection to those wishing to purchase reliable silks. The extent to which the weighting of silk can be carried is almost incredible, and I have here a skein of spun silk which has been weighted by a Lyons dyer 920 per cent. or 160 oz. per lb. Another skein of black suple, dyed in Germany, and weighted up to 80 oz. per lb. The three sample lengths of dress goods I have here, I recently purchased in a London shop; they were declared to be all pure silk, and could be depended on to wear well, the name of a Lyons manufacturer being given as a sort of guarantee. Analysis shows that the black and green brocade contains only about 45 per cent. of silk, the remaining 55 per cent. consisting of tin in the green and iron and tannin in the black. The better of the two black satins shows a slightly heavier adulteration, whilst the other satin is rather more than two-thirds metal, chiefly iron. English manufacturers and dyers have not joined in adulterating to this fraudulent extent, hence English silks still retain their character for genuineness and durability, and the Admiralty, realising that it was next to impossible to get genuine silk from abroad for the black handkerchiefs used by the sailors of the fleet, have restricted the weight of dye to $16\frac{1}{2}$ oz. for warp and 20 oz. weft, and the whole of these handkerchiefs, averaging annually about 100,000, are now made in England.

Amongst other difficulties we meet with I must particularly mention the heavy rates which the railway companies charge for the carriage of silk, whilst under the Carriers' Act they are exempt from any responsibility on parcels of a greater value than £10. Silk goods can of course be declared and insured, but the cost of this, added to the heavy carriage, is not only a burden but an injustice. Many articles equal in bulk and value, and just as liable to loss and injury as silk, are carried with the statutory protection. The Silk Association has made strenuous efforts to obtain the amendment of the Carriers' Act as affecting silk goods, and they have received the energetic support of the Members of Parliament representing various silk Divisions, but so far we have reaped no benefit.

In connection with this matter, the following extract from the report of the Silk Association for 1902 will be of interest:—

"In many cases the classification of certain silk goods in the highest class is an injustice, which, added to the anomaly of the Carriers' Act, contrasts very unfavourably with the position in which the British merchant and manufacturer finds himself as against the practice on the Continental railways. In this connection we may state:—

"(1) All carriage in France is entirely at the responsibility of the Companies without extra insurance.

"(2) Outside France the Convention of Berne necessitates insurance, but this may be met without additional expense by carriers (Clasquin and others) who have a permanent running policy against loss.

"(3) Silk or cotton goods or other textiles are dealt with on a uniform basis.

"(4) Cost of carriage in France for goods of silk, cotton, &c., per cwt. per 100 miles, 1s. 1d.

"(5) Cost of carriage in England (without guarantee) per cwt. per 100 miles, 2s. 2d.

"When it is further remembered that the English manufacturer has to pay, both on the carriage of his raw material to and from the factory and the dyer, and again in sending out his manufactured goods, it will be observed how this disadvantage increases as against his Continental competitors."

III.—Present Condition and Future Prospects.

Under the adverse circumstances I have described it is almost a wonder that any manufacturers exist, but we still have a British silk industry which, far from being in the decaying and dying condition some people believe or imagine, is displaying much vigour and enterprise and is worthy of being retained as one of our national industries. Certainly the struggle has been and still is extremely hard, and the manufacturer who has managed to exist until to-day has done so by reason of his ability, thorough practical knowledge, closer application of economy, study of every detail in manufacture, and by dogged perseverance in face of a storm of competition compared to which that of 1860 was but a gentle breeze, for in addition to the French industry, which still retains much of its old skill, we have competition from other markets, such as the German, Swiss and Italian, which possess still greater advantages in respect to cheaper labour, and now that the American market is closed against their products, the exporting energy of these countries is concentrated here. Modern fashion with its demand for the cheapest silks, also tends to help the foreign manufacturer rather than the home producer of richer qualities, in the price of which the cost of labour plays a less important part. Also cheap and rapid transit have done away with the advantage the English manufacturer once held by being nearer the home market than his foreign rivals.

I need deal no further with the conditions under which our silk industry is carried on, but will now endeavour to give you some account of the leading manufacturers and their productions. I will begin with Macclesfield, which town affords us a striking example of British determined perseverence in face of declining trade and consequent heavy losses, and ready adaptability to substitute new ideas to fill the gaps caused by the encroachments of foreign competition and ever-changing fashion. A proof of this is the large trade carried on here in the printing of Japanese plain and figured silks for exportation to the Burmese and other markets in the Far East, and in the making-up of vast quantities of thin silk into ladies' neck wear and other fancy articles. Some of the largest and most important manufacturers in this district are—Messrs. J. and T. Brocklehurst and Sons, whose chief productions are handkerchiefs, scarves, gum twills (both plain and figured), satins and foulards, for dresses, skirtings and light fabrics, for the Burmese market; Messrs. J. Birchenough and Sons, who make handkerchiefs, scarves, and mufflers, of the richest quality, for men's wear, fancy crêpes, and other fancy goods; and the enterprising firm of Messrs. J. Kershaw and Co., celebrated for ladies' neck wear, fichus, &c. In Macclesfield also are woven the black silk handkerchiefs for the Jack Tars of the British Navy, to which I have already referred. This order, formerly given abroad, is now by the wise decision of the Admiralty, confined to British manufacturers, and although open to competition, the bulk of it is usually secured by Messrs. Brocklehurst and Messrs. Birchenough, the excellence and genuineness of whose manufacture have led to the happy result that the Jack Tar once more proudly wears his kerchief which, in the days of foreign supply had become unpopular, owing to the rapidity with which it wore out, and to the black stain which was always traceable whenever it was worn.

The town of Leek is renowned amongst silk centres; for it is here that the famous silk printing and dyeing works of Messrs. Sir Thomas and Arthur Wardle, and of Messrs. Hammersley and Co. are situated. At the former, the principal work is the dyeing of permanent dyes for embroidery, sewing, and other silks, by pure and perfectly fast processes, and the dyeing and printing of silk piece goods; also the dyeing of skein silks, in blacks and colours, both pure and weighted, which has reached a standard of excellence not excelled by anything being done abroad. Leek is also noted as one of the very few towns where the silk trade has prospered, there is but very little weaving, the output consisting almost entirely of sewing and embroidery silks, bindings, braids, and trimmings in the production of which goods the principal firms are Messrs. Brough, Nicholson, and Hall, A. J. Worthington and Co., and Wardle and Davenport. At Coventry, the silk trade that remains has varied very considerably, the old industry of ribbon weaving having been replaced by what may be described as the "odds and ends" of the silk trade, such as tubular ties, ladies' belt webs, brace webs, coat suspenders, silk portraits, bindings, labels, boot loops, and tabbings, elastic web, hat-bands, masonic ribbons, shirt labels, frillings, badges, sarsenet and China ribbons, for tying-up purposes, book markers, &c. The principal manufacturers of these goods are Messrs. J. and T. P. Caldicott, T. Stevens, J. and J. Cash, F.

Bagley, and W. Franklin and Sons. Of the other silk towns, Braintree stands first to-day, both for the beauty and extent of its silk productions. Established here are the two well-known manufacturers, Messrs. Courtauld and Co., Limited, and Messrs. Warner and Sons. The former (Messrs. Courtauld's), who have also extensive factories at Bocking, Halstead, and at Leigh, in Lancashire, have a world-wide reputation for their manufacture of crêpe, for which they were awarded the "Grand Prix" at the Paris Exhibition of 1900; they also make large quantities of the present day fashionable dress materials, such as crêpe de chine, crêpon, chiffon, mousseline de soie, and all those materials of a soft, draping, diaphanous nature with which the fair sex delight to enhance their charms.

The firm of Warner and Sons, of which I have the honour of being a member, has only of recent years carried on its work at Braintree. It was founded at Spitalfields by my father, Mr. Benjamin Warner, whose skill, taste, and pluck enabled him to build up and carry on a business of manufacturing silk brocades, whilst all around the industry was decaying aud tottering to its fall, and he has done more than any man living to bring to the front that branch of the English silk trade with which his name will ever be associated. The goods made at my firm's factories are of a rich and elaborate nature, such as duchesse satins, rich dress brocades, twills, gros, lustrings, reps, glacé and watered silks, velvets (both plain and figured), damasks for ecclesiastical and furnishing purposes, and other heavier makes for upholstering, such as brocatelles, damasquettes, lampas, figured poplins, silk tapestries, and other specialities of silk weaving. Much study has been devoted to the use of gold and silver threads in woven fabrics, in consequence of which I shall always be proud to remember that we were able to make the cloth of gold for His Majesty King Edward's pallium and also for the canopy used at the Coronation. We also had the honour of making the figured border worked in various gold threads for H.M. Queen Alexandra's Coronation robe, and the purple velvet for the robes of H.R.H. the Princess of Wales and other members of the Royal family, whilst in our velvet looms at Sudbury in Suffolk were woven many hundreds of yards of crimson velvet for peers and peeresses. Another firm of Essex manufacturers is Messrs. Bailey, Fox and Co., in whose power looms are made satins for vestings, dresses and linings, serges, facing silks of all kinds for tailoring purposes, striped sleeve linings, satinettes, black gros, ottomans, and other robe silks, also moiré antiques for which English manufacturers have always been renowned. They also have hand looms in Spitalfields and at Sudbury, in which are made velvets for court suits, coat collars, &c.

Whilst speaking of Sudbury I may mention Messrs. Vanner and Fennell Bros., whose chief product is umbrella silk; it is silk we do not often get now-a-days, it will last as long as stick and frame, and at the end of two years' constant use it will with reasonable care still be sound.

The industry in Spitalfields is interesting for the reason that the few looms which remain are still worked in the weavers' cottages in the old-fashioned way. Messrs. Buckingham and Co., Messrs. Vavasseur, Carter and Co. and Messrs. Slater Bros. are the principal employers in the district, the looms of the former being entirely engaged in making rich quality silk for cravats, such as are retailed in the best West End shops. The well-known firm, Messrs. J. Pearsall and Co., are large manufacturers of both twisted and thrown silks for embroidery and weaving purposes. Of the firms not situated in the old silk centres, Messrs. Lister and Co. Limited, of Manningham, Bradford, are worthy of first notice. Employing over 5,000 workpeople, they are by far the largest silk manufacturing firm in this country, and claim to be the largest in the world. Their products are of a great variety, for in addition to being extensive spinners of silk, they manufacture dress and furnishing fabrics, silk tapestries, Genoa velvets, antique velvets, velvets for millinery, dress, and collar purposes, plushes, tussahs, pongees, fancy silks, fringes, trimmings, sewing silks, twists, &c. But their most marvellous productions, in my opinion, are the silk piled seals, beavers, fox, ermine, mole, minever, &c, which are simply wonderful as imitations of the skins they represent, and it is not surprising that their goods find an enormous sale in Paris, Berlin, and practically all over the world.

Messrs. Robinson and Millington, whose works are at Patricroft, Manchester, are principally engaged in making that class of goods which has been harder hit by the foreigner than any other, and it is very much to their credit that they are so successfully holding their own. Their productions are entirely dress materials, such as brocades, satins, gros, failles, moiré antiques, armures, and foundation silks.

At Sherborne, in Dorsetshire, is the old-established business of Messrs. J. and R. Wilmot, Limited, whose factory has been at work since 1760. It was entirely engaged in silk throwing until 1889, when the falling off of the trade, through Italian competition, induced them to set up power looms in which are made large quantities of the best class foundation silks, satins, checks, brocades, &c. There is still some silk weaving at Yarmouth, Norwich, and other places, but those I have mentioned are typical of the industry as carried on in this country.

I ought not, however, to leave this subject without referring to the silk lace industry at Nottingham. This beautiful material has not been fashionable for the last ten years, but the demand for it is now showing signs of improvement, and a few manufacturers have again mounted machines with silk, but it is too early to speak about results. The trade here is divided into three distinct classes.

The first make lace proper, viz., large and in many cases elaborate designs. The second make light goods with spots or sprigs suitable for veilings and for trimming hats and bonnets. The third, which is the most important branch of the trade, make plain net for endless purposes, frequently for embroidery, a large trade being done with the embroidery centres.

In addition to the lace industry in Nottingham there are large hosiery manufacturers in the town, who use a considerable quantity of silk in various forms for hosiery purposes.

Before concluding my remarks on English silk productions, I will briefly refer to silk throwing and the spinning of spun yarns. The former is the process of doubling and twisting the raw silk into a weavable thread, either for warp or weft purposes, and it is to be regretted that this has not been so successfully done here as in France or Italy. Many of the largest manufacturers, whose names I have already mentioned, throw silk for their own requirements, but silk throwing as a separate industry is now but little carried on in this country. Of the best throwsters I may mention Messrs. Chas. Woollam and Co., of St. Alban's, and Messrs. Anderson and Robertson, of Glasgow, who have a well deserved reputation for turning out a sound and reliable thread.

The spinning of waste silk and spun yarns is, on the contrary, not only a very large industry in this country, but our spinners make the finest qualities and counts in the world, and their products are extensively used in the lace trade of Calais, St. Etienne, Lyons, and other silk-consuming centres. The utilisation of silk waste, which consists of the floss which is removed from the exterior of the cocoon before reeling, unreelable cocoons or the remains of those from which the reelable thread has been taken, waste from the reeling and throwing processes, &c., and its conversion into yarn, we chiefly owe to the inventive genius of Mr. Lister, now Lord Masham, and it has resulted in a very large addition to our available supply of silk, as the waste amounts in quantity to about one-third of thread ruled from the cocoon. The great centres of the silk-spinning industry are at Brighouse, Halifax, Manningham, and other Yorkshire towns. A yarn called "Schappe," similar to English spun, is largely produced on the Continent by a slightly different process, which in ordinary qualities has made serious encroachments on the home product, both in this and foreign markets, and it is chiefly in the finest counts that the English spinner is holding his own.

As to the future of the industry, it is, under existing circumstances, impossible to speak hopefully, although we shall in all probability retain what we now hold. Forty-three years exposure to the killing competition of the world's lowest-priced labour, has removed all, or nearly all that was assailable, that which remains exists by virtue of its undeniable merit in technical skill, genuiness of quality, and excellence of design and colour. There has been admittedly of late years a vast improvement in taste and knowledge of design in this country, resulting in an appreciation of and demand for purer and more beautiful styles. The grotesque hideousness of the Victorian era has passed away, and following the example set by the genius of William Morris, English draughtsmen have established a school of design which may be said to stand, if not alone, certainly first in the world to-day for originality and merit.

The study of colour, which I consider of even greater importance than design, as regards textile fabrics for dress and upholstery purposes also shows vast improvement, but it would be absurd to claim that we have nothing further to learn in this respect, and we can only hope that the increased attention that is being given throughout the country to matters relating to art will enable us to obtain even better results.

The present taste for colour shows a tend-

ency in the right direction, the days of dowdy, muddy semi-tones, are passing away, and the demand is for richer, purer colours, such as we associate with the best days of Italian art.

As to the revival of the industry, it is most essential that, for economical reasons, the locality should be taken into consideration, and if we are to succeed we must not allow any absurd conservatisms or sentiment with regard to localities to mar our efforts. Spitalfields, for instance, if we put aside sentiment, is now altogether undesirable and utterly impossible for silk weaving. When the industry first settled there, the weavers' houses were built on what was at that time open fields; rents were low, the light was unimpaired, and the atmosphere free from smoke and grime, and, in those days, of slow and costly transit, it was most essential that the weavers should be near to the centre of distribution, so as to effect a great saving in time and expense.

All these things are now completely changed, and it would be a serious mistake for any one, whether from philanthropic or other motives, to endeavour to restore the industry in a locality so heavily handicapped by excessive rentals, dull, gloomy light, and dirty surroundings.

There is absolutely no hope for those who still cling to obsolete ideas, but I find that where manufacturers show originality and enterprise, and adopt the most modern and economical methods of production, they have mostly succeeded in finding a market for their goods at remunerative prices, and I am confident that in some directions even more might be achieved, although in the lowest qualities which form the great bulk of silk goods used, and the sale of which, by the manufacturer to the merchant and distributor depends, in many cases, on the fraction of a farthing per yard, all the skill and enterprise in the world will not overcome the substantial advantage which the foreign producer possesses with his vastly cheaper labour. There is but little chance of the price of foreign labour becoming as costly as our own, and we are therefore bound to face the difference in the cost of production which, so long as our own ports remain open, is an insurmountable difficulty, and to ask ourselves the question whether it is better for our national welfare to rest content with our present shrivelled silk industry, or to modify the conditions under which it exists, and enable it to become great and flourishing. We have in this country the skill, the means, and the market, the only thing required is power to prevent our being undersold, and this can only be done by protective duties. Raw silk should of course be admitted free, as we do not grow silk in this country, and therefore do not reel it, but an *ad valorem* duty of 5 per cent. should be placed on imports of thrown silk, spun, schappe and tussah yarns, and another 5 per cent. if imported already dyed. On woven silk fabrics of all kinds there should be a duty of 20 per cent., with an additional 5 per cent. if made up into gowns, costumes, and other finished articles ready for wear. Safely sheltered behind such a barrier, by no means prohibitory, capital and enterprise would rapidly assist those other qualifications we undoubtedly possess in building up a great silk industry, capable of supplying the requirements of the home market, and of our colonial markets also, should they be added by means of a preferential tariff.

It may be thought that the revival here of silk manufacturing in its various branches would be a matter of considerable difficulty, but by the adoption of up-to-date power machinery an increased output is easily possible, as the labour required for attending power looms and other power machinery is much more rapidly acquired and trained than would have been the case fifty years ago, when the bulk of the goods were hand-woven, although there is no doubt that a great impetus would also be given to those goods for which hand looms are still absolutely essential.

It is quite a usual thing for silk manufacturers to be told by those not engaged in the industry that their salvation can be more easily and effectually secured by improving their methods of manufacture and by means of technical instruction. In reply to the first exhortation, I find that English manufacturers are for the most part keeping well abreast with the times, and are not the sleepy antediluvians that some people imagine. On the contrary, there is a desire to benefit by every new invention, and the manufacturers possess individually a better knowledge of the technique of silk manufacture than most of their foreign rivals. As regards technical education we have been admittedly behind Germany, and even now we are at best only muddling into it. Technical education is a very excellent thing, but much money can be, and is, wasted on it, large sums being annually frittered away by the various County Councils throughout the country on nearly useless subjects, such as wood-carving, poker-work, &c., which are generally taken up

by a certain class of people as mere hobbies and nothing more, to the sacrifice of the more solid teaching in those districts where *bonâ-fide* industries exist. The silk industry, however, has not much cause for complaint, as its chief centres such as Macclesfield, Leek, and Coventry, it has excellent technical and art schools, the former of which are fitted with looms and machinery of the most modern kind, and large numbers of candidates from these schools pass annually through the examinations of the City and Guilds of London Institute, giving evidence of a thorough practical training which fits them to enter the lists of silk workers in various capacities. Unfortunately, the industry, owing to its present undeveloping condition, cannot give them employment, and they either go abroad or pass to other occupations, so that the money spent on their early training is to a large extent wasted. To put it into the words of one who has spent many years in connection with silk instruction: "There is really no encouragement for a man to study and find out things, as there does not seem any market for him to sell his knowledge."

At Manchester, the "Municipal School of Technology" recently opened, has a special department devoted to silk manufacture, capable of giving instruction in its highest form, and when on my visit there a few weeks ago I was much struck with the wonderful completeness of the arrangements for instruction in silk spinning, throwing, and conditioning, as well as in all those operations of preparing the silk for the loom, such as winding, mill and sectional warping, turning on, &c.

There are looms for every kind of silk weaving, such as treadle, Jacquard, and ribbon hand-looms, English and foreign Tappet, Dobby, and Jacquard power-looms, with single and multiple boxes, and Jacquard swivel-looms, and, in fact, so complete in every arrangement that I would strongly advise manufacturers to send their sons here for a course of study, which is as good as, or better than anything existing abroad.

The silk dyeing department is also on the latest principles, and connected with it is a special laboratory for analysis and other chemical work relating to dyeing.

To the great and valuable assistance which these technical schools have been to the industry, must be added the kind interest and practical help which our Royal Family and many members of the aristocracy have so generously given, and although I cannot speak of the silk industry as having in any sense revived, I can honestly say that I firmly believe that its condition to-day would have been infinitely worse without their valuable support and influence, and I should like to give a brief review of the benefits that the trade has received at their hands.

About the year 1873, the attention of the upper classes was called to the fact that great progress was being made in the manufacture of high-class silks in this country. Previous to this, it was the accepted opinion that English manufacturers could not produce goods equal, either in design, quality, or execution to those made abroad.

In the spring of 1882, the Hon. Mrs. Percy Mitford visited Spitalfields for the purpose of ascertaining the state of the trade there. A meeting was afterwards held at the warehouse of Messrs. H. W. Eaton and Sons, in Broad-street, which Mrs. Mitford kindly attended and spoke of the necessity of efforts being made to revive this industry, for which she felt a warm interest, and, I am pleased to say, still continues to do so.

At the Manchester Jubilee Exhibition, in 1887, still further notice was taken of the progress made in English productions, and the Silk Association of Great Britain and Ireland was formed under the presidency of our chairman this evening, Sir Thomas Wardle, with a council composed of those engaged in the trade, together with many who felt an interest in the cause.

In 1890, a Silk Exhibition was held in St. James's-square, at the house of Lady Egerton of Tatton, who at this time held the position of honorary secretary to the Ladies' Committee of the Silk Association. As a result of this exhibition, the Ladies' National Silk Association was formed and H.R.H. the late Duchess of Teck graciously consented to be president, and entered warmly into the matter.

The following extract is taken from the first report of the Ladies' Committee:—

"We consider that the time has come to invite the attention of the ladies of England to the revival of this ancient industry. In order to do this the committee propose to form a Ladies' Silk Association on an extended scale. Its members will not be pledged to the exclusive purchase of English made silks, but they will be asked to interest themselves and their friends in this British industry, and to make enquiry for and inspect English silks before deciding to purchase those of foreign manufacture. We trust that

before long ocular demonstration of the excellence of English silks may be afforded by an exhibition. Should success crown the efforts of those who have been working on behalf of the silk operatives in England, Scotland, and Ireland, they will feel rewarded by the knowledge that the time and energy they have devoted to this enterprise have resulted in increased prosperity to their working brothers and sisters in silk factories."

A series of visits to the principal silk centres was then arranged, and in March, 1893, Her Royal Highness the Duchess of Teck, with Princess May visited my firm's factories in Spitalfields and made a minute examination of the brocades and other goods being woven.

By the kind consent of the Duchess of Sutherland a second exhibition was held at Stafford House in 1894, in which Her late Majesty Queen Victoria took a deep interest, and which was visited by the then Prince and Princess of Wales (our present king and queen) and a great number of the royal family—and still further demonstrated the continual improvement made in the manufacture of silk.

The Duchess of Teck afterwards visited the silk factories at Leek and Macclesfield, the inhabitants of which did their utmost to show their gratitude for all that was being done by her to promote the welfare of those towns. The determination shown by Her Royal Highness to support in every way this branch of English trade, and the assistance given by other members of the ladies' committee, together with the untiring efforts of Sir Thomas Wardle, president of the parent Association, have, by giving great encouragement to those engaged in it been most beneficial. After the deeply lamented death of Princess Mary, Duchess of Teck, the Princess of Wales (then Duchess of York), graciously consented to become president, and by her personal interest and continual help in insisting on being supplied with British silk whenever possible, has very substantially forwarded the aims of the Association, and I am quite sure that I am only expressing the feelings of the whole industry in saying that we heartily appreciate all that Her Royal Highness and others have done and are doing for us.

IV.—Description of the Exhibits.

Among the exhibits I have here this evening, none will be of greater interest than the old Canterbury pattern book dating from 1684, containing specimens of the work first done by the Huguenot refugees on their arrival in this country. Of the two other books the first one dates from 1760, and is contemporary with the Louis XV. period in France. It contains brocades magnificently worked in gold, silver, and various coloured tissues, mostly of French style, the beauty of the colours and designs showing that at this period Spitalfields was at its best.

The other book is from 1856 to 1860, the period of gloomy colours and ugly styles, relieved only by the lovely work then done in moirè antiques. A few old patterns represent Spitalfields brocades about the year 1851, they are not beautiful, and it is almost impossible to believe that those who manufactured them were descendants of the people who, 100 years previously, working with all the disadvantages of the draw boy, made such wonderful specimens as those contained in the 1760 book.

Many of the specimens of dress silks exhibited this evening possess special points of interest, particularly this charming piece of "Guelder Rose" which was designed by Miss Ada Muir, of the Royal Female School of Art; this pattern, and also the "Sweet Pea" design, with its delicate tracery of silver on soft green ground, are made exclusively for Messrs. Liberty, who have done so much to encourage and promote the production of beautiful textile materials in this country. The two specimens of Cloth of Gold, the one deriving its beauty entirely from the warp and the other, very different in appearance, from the weft, are reminiscent of many a gorgeous Mediæval pageant, and although they cannot strictly be classified as silk goods, being composed chiefly of metal threads, it is in conjunction with silk that they derive their suppleness and peculiar charm.

The lengths of wide silks which surround the walls of this room are chiefly for upholstery and decorative purposes. I have grouped the different styles as much as possible together, and will describe those representing the Italian first, as in my opinion no other style can equal it for beauty and grandeur. One of the most strikingly beautiful specimens is the ecclesiastical brocade, Milanese, late 17th century, woven in silk, gold and silver, the design consisting of leaves, flowers, and fruit on a rich crimson ground. The bold design of crimson and gold damask is also representative of the 17th century period.

In Venetian styles, the oldest is the green ground, with figure worked in metal threads, typical of 16th century art. The other two

Venetian designs I have here, the one on the green ground with coloured flowers, reproduced from the old figured velvet in South Kensington Museum, is early 18th century, and the other —the red and white brocatelle, is of slightly later date, probably the middle of the same century; both of them are much less severe in style than designs of the earlier Italian period, and seem to be somewhat affected by the French art of that epoch. The wall-hanging on old crimson ground, with flowers, scrolls, and birds, brocaded with silk and gold threads, is an excellent example of Florentine art of the latter part of the 17th century. The specimen of *fleur de lys* on old damask ground, is of course emblematical of France. The origin of this heraldic emblem is unknown, but it was used on the coats of arms as early as the 12th century, and its popularity as an emblem in France dates from the 13th century.

The blue ground silk, with crown and salamander brocaded in gold, is peculiar to Francis I. period. The green brocatelle is Louis XIV. style, and the brocade on old rose ground is typical of the same period, early 18th century.

The Louis XV. period is prolific in brocades, worked chiefly in chintz colours. I have here several specimens of the style; the design on the cream armure ground is by a modern French artist, but the purest specimen is the blue ground brocade, which is an exact reproduction of the old original.

One of the most lovely brocades is the one on blue satin ground; the original was a portion of an old curtain, which was rescued from the Palace of St. Cloud during its destruction by fire in the Commune of 1871. The date of its original production was about the year 1760, and the old piece from which this has been produced was kindly given me by Mr. F. Bennett Goldney. There are also specimens of the Louis Seize and Empire periods, the original of the latter being in the palace at Fontainbleau.

Of the English styles I have selected, the Elizabethan is the earliest of which it is possible to find existing specimens; they vary in nature according to the source from which they were obtained. Some of them are very Italian in style, others Flemish or German, they conform to the style of architecture of the period, but it is unlikely that any figured furniture silk fabrics were woven in this country at this early date.

The damask in green and white is from a design by Mr. Henry, it represents the style of English ornament of the period of Sir Christopher Wren. One of the most beautiful periods of English styles is the latter part of the 18th century, the days of Sheraton furniture and Adam's design and ornament, it is frequently called the English Louis Seize, but in my opinion it is, from its distinctiveness, chasteness, and quiet beauty, a style quite apart from the gaudiness of French contemporary art. The design of the carnation green and ivory is from an original Adam, and the stripe design on the rose is by Mr. Henry. I also have here several damasks and brocades made in modern English designs; the "Crown Lily" design is by Miss Watson of the Royal Female School of Art, and was awarded the last gold medal presented to the school by Queen Victoria.

The design on foliage ground with large aconite flower is by Mr. S. P. Butterfield. I have two examples of Mr. S. G. Mawson's designing, the large scroll pattern of acanthus leaf and lotus flower in crimson with old metal effects is Venetian in inspiration—the other pattern of semi-natural foliage is in the Morris style.

There are two specimens of the so-called "new art" style which sells more readily on the Continent than in this country.

For ecclesiastical work the design woven in purple and gold was taken from an Italian brocade of the early 16th century; the very beautiful fabric in white and gold is modern, and was designed by Mr. L. Silas.

The design of the rich red and gold material is taken from the painting by Vander Goes of the "Madonna and Child" in the National Gallery. The two lengths of narrow damask are produced to imitate as closely as possible the effect of old material. They are, of course, sold as reproductions, and are exceedingly useful for covering old furniture or for decorating rooms in the old style; the length of crimson is of pure cochineal dye.

In Italy this reproduction of old fabrics is very largely carried on, and they are, unfortunately, not sold as imitations, but as the genuine old originals; the material is cut up into what appears to be panel or curtain lengths, a few patches are put in here and there, the selvages are turned over and tacks put in at intervals as though they had just been removed from the walls, and they are then sold at three or four times their value to credulous foreign tourists, chiefly English and American, and it is not surprising

under the circumstances that the supply of old damasks from Italian castles seems quite inexhaustible.

The piece of crimson and gold brocatelle, the design of which is copied from the covering of a Sedan chair used on State occasions by King George III., is worthy of remark owing to its being made entirely from silk grown in Kashmir. It is only eight years since my firm wove into goods the first parcel of Kashmir silk that came into this country, and we were then able to report most favourably upon it, since that time improvements have been made in the reeling of the thread from the cocoon by the introduction of European overseers and machinery.

This comparatively new industry, through the energetic aid and sound advice of Sir Thomas Wardle, is making rapid strides, and is bound to become a great boon to the native population of that Province of India, and it is with pardonable pride, and with a feeling of indebtedness to him, that we regard this valuable industry growing up within our Empire, which will, in the near future, not only provide us with large supplies of raw silk, but with a thread as even, bright, and beautiful as anything the world produces.

And with this brilliant example of what energy and ability may achieve, I will bring my paper to a close. To what extent these virtues have contributed to the existence of our present British silk industry I must leave others to judge, but of their necessity in the future I am convinced; the day has gone by for the lethargic *laisser faire* treatment of any industry, and whatever our future fiscal conditions may be, it is our duty as Englishmen to strive, with all our might and main, to retain this ancient, beautiful, and fascinating craft in our midst.

DISCUSSION.

The Hon. C. H. STRUTT, M.P., thought all present must agree that the exhibition of the various arts expressed in the silk work of different countries at different times was a liberal education, and must congratulate Mr. Warner on his excellent and instructive paper, but he did not altogether agree with the remedies suggested by the author for the improvement of the industry. The author looked to Parliament, and hoped that in the coming time something would be done for the silk industry as well as the other industries up and down the country. Mr. Warner expressed the opinion that there were two things which interfered very much with the silk industry; the first was the competition of low priced labour abroad, and the second was "dumping." He (Mr. Strutt) had more sympathy with the second complaint than with the first. In his opinion "dumping" was a thing which should be put a stop to in England; he did not believe that anybody gained by purchasing things below their cost price, in addition to which it destroyed trades. With regard to fiscal reform, he thought the time had not yet arrived for the measure suggested by the author, they must feel their way first. It was a large claim to make that a trade in one country must be supported because another country could make particular articles cheaper. England might find itself forced in that position some day, but he thought at present what was wanted was to stop unfair competition of every sort and kind; where competition was fair and above-board they must try by their own skill and enterprise to fight it. His own experience was that the author's firm had not endeavoured to fight it by reducing the wages of their *employés*; he thought he might fairly say that there were no better paid men in the trade, nor men more cordially inclined towards their employers in any part of the country than those of the author's at Braintree. As time went on he hoped the silk industry in England would continue to flourish.

Mr. WILLIAM COLDSTREAM said the Chairman's name had been long familiar to him in India as one who had wisely devoted much time and attention to the cultivation of tussah silk, in which he (Mr. Coldstream) had been long interested. Although tussah silk was largely cultivated in India at present, the output could be enormously increased. From his own experience in the Punjab he believed that cottage cultivation of tussah might be found possible in India. He understood that it was a valuable item in silk production and manufacture in this country, and he would very much like to see the industry of tussah silk growing in India developed by a demand for the article in this country. He thought that full information as to the possibility of the large cultivation of this silk in India should be known in England.

Mr. H. H. HEXTALL said he was glad to hear from the last speaker that the possibilities of the production of tussah silk in India were so great. Personally, he had never heard of Indian tussah before, all of that class of silk with which his firm dealt coming from China. If it was possible to produce tussah in India, he thought it was a great pity that a throwster like himself did not know of it.

Mr. COLDSTREAM said he would be happy to afford any information on the subject. Tussah silk was an indigenous product in India, and was, he believed, capable of almost any development.

Mr. Hextall said that with regard to the author's remarks on the subject of protection, he thought the suggested duties were somewhat unfair. Mr. Warner proposed a 5 per cent. *ad valorem* tax on imported thrown silk, and a 20 per cent. *ad valorem* duty on woven silk. His friend, Mr. Woollam, would agree with him that the throwing industry in this country was in a very low state indeed, and why they should be left out in the cold with a 5 per cent. duty, and their friends should have a 20 per cent. duty he could not see. That was one of the great difficulties which arose when protecting industries in any country; men would consider their own pockets as opposed to the interests of their country.

Mr. L. Foreman Day thought that any artists present, especially those connected with design, could not but be struck with the beauty of the material with which the reader of the paper had to deal. He had been struck at seeing very many designs, some of them beautiful and others the reverse, which were reproductions from old silk not of the finest period. One or two of the examples of 16th century work were good, but the majority began at 17th century and went on to the 18th, which was not a beautiful period of design. His own impression was that the following of the 17th and 18th century designs was very desirable from the point of view of the decorator but not from the point of view of art. If patterns of old silks were required there were the old Sicilian silks, the earlier Italian silks, and the gorgeous 16th century brocades, of which the best 17th century patterns were poor copies. It was a pity that so much beautiful silk was woven in the present day in patterns not due to British design. That was not the fault of the British designer; it was probably not the fault of the manufacturer, but of the middleman, the upholsterer, who, for trade purposes, found it necessary to have patterns in the style of the Louises. Something had been said about the fiscal question. He ventured to express an opinion contrary to that of the reader of the paper. The way to meet foreign competition was to make something special of our own. It was not the proper way to meet French competition for Englishmen to weave French patterns: why did they not weave English patterns? The lecturer also said something about fashion, and said that some of the modern loaded silk would wear quite long enough for the prevailing fashion. There again fashion was the demon. Loading silk was against good material; but one reason why there was so much cheap silk nowadays was that nobody wanted to wear a dress more than one season, and people wanted their houses done up every two or three years to show how exceedingly rich they were. A great deal was heard about Imperialism, and Englishmen were bragging all over the face of the earth; but they had not yet adopted anything like a British style or idea of design.

Mr. Charles Woollam thought many present would probably not agree with the last speaker's ideas on the fiscal question. Probably Mr. Day did not know the difficulties and troubles of those who were engaged in the silk trade. Speaking as one who had been engaged in the trade from his very earliest years, he knew that not only had the difficulties continued to grow for many years, but they had now arrived at a point where trading was rendered absolutely impossible. He did not believe that, under the present system, it was possible to recover the position that the silk trade once held in this country.

Mr. A. J. Solly (of Messrs. Reade and Co., silk spinners, Congleton) after thanking the author for his paper, said that he represented the town of Congleton, which had almost ceased to exist as a silk centre. The paper had been an encouragement to him as the representative of a very old firm, and he was pleased to see there was so much life left in the silk trade. He was sure all present agreed that a trade which was capable at the present day of producing such silks as were exhibited was too good for the country to lose. He was not a silk manufacturer, nor could he claim to have a share in the artistic side of the silk trade. He was a silk spinner, as four generations of his family were before in the same firm, and dating from 1782, when his great-great-grandfather began as a silk throwster and manufacturer, they had, by dint of very hard work, survived in himself and a partner to the present day. Lord Masham, whom the author referred to as the inventor of silk spinning, had sufficient credit belonging to him for the invention of his wonderful plush looms and also of the wool comb to entitle him to all the honour given to him; but he was not the pioneer of silk spinning. His (Mr. Solly's) own firm was spinning waste silk when Lord Masham was still in the nursery, and his own firm was not the oldest. He thought there was one firm still existing, Messrs. William Thompson and Co., who were spinning a few years before Messrs. Reade and Co. started. Congleton was once a flourishing silk town. When he was born there were forty silk-throwing mills and two silk-spinning mills; of the former only two survived at the present day, but the two silk-spinning mills were still in existence. In the silk-throwing mills 40 years ago 3,500 men were employed; to-day there were only 65. That condition of things, he maintained, was not due to any lack of technical education or enterprise, but simply to the unfair competition of foreign labour unhampered by any legislative restrictions. The silk trade suffered from many disabilities. Very rightly our work people were protected from the evil effects of excessively long hours, of working under insanitary conditions, and to the annoyance of their neighbours by means of the processes adopted. For instance, the process of boiling off or discharging the silk in Switzerland consisted of fermenting the silk instead of boiling it, as was done in England; fermentation was excessively annoying, in fact impossible, in a crowded

neighbourhood in England; therefore it was practically against the laws, and Englishmen were debarred from adopting that process. It was very much cheaper than the one they were compelled to resort to of boiling the silk, at great expense of soap, steam, and labour. The female workers were not allowed to work more than 55½ hours in this country against the 70 hours or more their competitors worked in Continental countries; there were also restrictions in regard to ventilation, and other sanitary regulations which their foreign competitors did not suffer from, and the women and girls were not allowed to work at night as was the case on the Continent. When it was realised that the wages in this country were just about double, for the short hours worked, those of the foreign wages for the longer hours, it would readily be seen that the English silk industry had almost a superhuman task to face. The fact that English silk spinners could send spun silk yarns into America against a 35 per cent. *ad valorem* tariff, the fact that his own and other firms were sending to France silk yarns against at least a 10 per cent. duty, showed that the English people were not behind the rest of the world in industry, knowledge, and capability. The best sewing silks, embroidery silks, and fancy yarns for dress fabrics were still made in England, and exported to France and America in the face of high duties. The author had suggested a 25 per cent. duty on some goods. He thought there were very few manufacturers in this country who would not be prepared to face the world with a 10 per cent. duty, and as that was nothing like the difference in the cost of labour on the goods, it was not much to ask. If they did ask for it, it was simply in order to keep the workpeople in possession of the same comforts in life and the same rewards of their industry which they enjoyed now, when times were only fairly favourable. They did not want any artificial protection, but wished to be treated with equality in the way of restrictions on the one side, and counter-restrictions on the other. He admitted that at present he was guilty of importing foreign yarns to do trade, which, under present circumstances was otherwise unpracticable, but the margin of profit was so small that even a 5 per cent. duty would not make that foreign yarn a necessity to him. He further said that very often business relations with the foreigner were impossible, because the foreigner was not satisfactory in his mode of treatment. He could get much prompter delivery and could rely upon much better conformity to quality in English yarns than in foreign. So much for the vaunted superiority of Continental business methods.

Mr. BENJAMIN WARNER said the fact that his son had read a paper at the Society of Arts was a peculiar pleasure to himself. He had been engaged in the silk trade all his life. It was over sixty years ago since he began to analyse textile fabrics, and study the technical part of the subject, and for the last forty-three years those engaged in that business in England had had a very sad experience. Many manufacturers had been ruined, thousands of the working classes had been thrown out of employment, some of the youngest and best had gone to America to enrich that country. The United States had made great progress in all their productions, and the effect was now being seriously felt in this and other countries. Conditions had altogether changed since the Treaty of 1860. At that time America had very few silk looms at work, but the progress of the country was illustrated by the following figures. In 1870 the value of silk productions was 12,000,000 dols.; in 1890 it was 87,000,000 dollars; and in 1902 it was 135,000,000 dols.; and she now purchased one-third of the raw silk which came into the world's market. America had also made a rapid progress in every other trade, and instead of being, as she used to be, a very large customer to Europe, she had become a keen competitor for many classes of goods. So much the worse for England. When he thought of the poverty in the East of London at the present time, and compared it with the prosperity that existed fifty years ago, when there were 26,000 looms at work, providing a living for 100,000 men, women, and children, he felt that some alteration in our fiscal policy was necessary. People did not like the word protection, but if the industries of the country were protected by any other name it would be just as useful. He believed that the present condition of things, which might have been suitable fifty years ago, was not good for the present time, nor conducive to the welfare and happiness of the people. If the country continued to permit one trade after another to be destroyed, many thousands of the working classes, who had the right to live by honest labour in the land of their birth, would be thrown out of employment, and we should take from many the power to purchase, and the distributer would then suffer as well as the producer.

The CHAIRMAN said:—Mr. Warner has in a most able manner treated his subject both historically and industrially, and he has led us to think of it in a threefold way, in fact, how up to 1860 it was a large and flourishing industry giving healthy and artistic employment to hundreds of thousands of people; how sadly it has declined since that time until it is now no more than a shadow of its former self; and with much hopefulness he has given us his views how it can be recovered and resuscitated. Mr. Warner has proved to us from Acts of Parliament that the silk industry existed in this country as early as 1326, a very high and venerable antiquity, in fact very much older than that of Lyons. I think that is a very important fact which we should not forget. I spoke of the silk industry last week at the Bradford Municipal Technical College, where I had the pleasure of presenting the prizes to the successful students. In my address I gave some statistics of the past and present state of the industry, how that in 1854 we imported only £2,225,000 sterling worth of manufactured silks

from the Continent, and that chiefly from France; how that in 1860, the year of the French treaty, the imports were only three-quarters of a million in excess of this figure, namely, £3,000,000 sterling worth, and how that in the space of one year only the imports leapt up in 1861 to £6,000,000, and that in consequence of our statesmen who went over to Paris to arrange the French treaty and allowed the more astute members of the French Senate to abolish the 15 per cent. duty, which up to that time was most materially protecting the interest of the English weavers and those engaged in the subsidiary branches. The prop removed, the industry gradually fell until in 1899 the imports of silks from the cheap labour silk centres of Germany, France, Switzerland, and especially Italy, rose to the enormous figures of £16,109,583, and the home industry was ruined. Manufacturers and artisans were impoverished, but merchants and importers were enriched, purely by distributing the cheaper labour products which poured into this country in such vast quantities. Mr. Cobden is reported to have said to those who pointed out to him that the removal of the 15 per cent. duty would be disastrous to the silk industry, "Well, let it go to countries where it more properly belongs." What do we think of all this now? Our presence here to-night is a speaking protest against it. We have to undo their want of foresight, and their ignorance of the conditions and surroundings of both the British and Continental silk industries, particularly the latter. It is the purest nonsense to assert, as some are so fond of doing, that our manufacturers want more energy, better machinery, more technical education. Let it never be forgotten that many of these very men, both masters and workmen, who migrated to the United States of America when they found their occupation gone, met with no difficulty in succeeding there, and raised up a silk industry which has now the record of manufacturing more silks than any other country. This was not the work of men wanting in energy or technical knowledge. It was, and is, impossible to succeed here against Continental cheap labour and hostile tariffs in the production of the plainer and most used silks. It is only a few silk industries of a special character which have held and still hold their own in this country. Take the Throwing branch as an example. Fifty years ago there were forty Throwing mills in the little town of Congleton; now there are only two and they are very small ones. How can they compete with the cheap labour of Italy, where to-day the wages of silk women are not more than 5d. to 7d. per day of twelve hours, and working these twelve hours every day in the week except Sunday. I have found the Throwing machinery of England quite as up-to-date as in Italy, in some instances more so. It is sad to think that English silk manufacturers have to go to Italy for the thrown silk they weave. Mr. Warner has told us of the desolation of Spitalfields, with its opportunities gone for ever. I well remember the gradual extinction of the trade in Manchester, Newton Heath, Leigh, Derby, West Houghton, and other places then renowned, where a larger industry was carried on than in Spitalfields. Coventry now, with its dozen of small manufacturers, had formerly upwards of eighty; Leicester, Nottingham, Macclesfield, Leek, all with vastly decreased weaving branches in plain silks, velvets, serges, &c., appeal for inquiry, information, and help. Professor Chandler, a distinguished chemist of America, told me, a short time ago, that his country had succeeded in making their silk industry so great by a prohibitive duty, not wanted for revenue, but to protect the people who had left us from Spitalfields, Coventry, Macclesfield, Manchester, and elsewhere, and he told me they did not want to buy anything from Europe they could help, and were resolved if they could to make it themselves. One of the American Government statisticians wrote to me, a few months ago, asking me if I had observed that the American silk industry had, in forty years, gradually flourished in the ratio in which ours had decayed, and said this could only be attributed to their fiscal system on the one hand, and to our want of it. In concluding my remarks, I wish to urge silk manufacturers to send their sons to the Manchester Municipal Technical School, where an admirable Silk Section has been provided, under the influence of the Silk Association of Great Britain and Ireland. I propose a hearty vote of thanks to Mr. Warner, and ask Mr. Kershaw, one of the leading silk manufacturers of Macclesfield, to support the vote.

Mr. THOMAS KERSHAW expressed the pleasure it gave him to second the vote of thanks to Mr. Warner for his very able and interesting paper, which was full of most valuable information. He also expressed his delight with the varied and numerous exhibits as shown round the room. They were indeed a credit to the firm of Messrs. Warner and Sons. A more beautiful selection of British made silk he had never seen. They not only reflected credit to the firm, but also to the silk trade generally, and with such productions it could never be said that the manufacturers and workmen of this country were wanting in skill, energy, adaptability, or resourcefulness.

The resolution was carried unanimously.

Mr. FRANK WARNER thanked the audience for the kind reception given to his paper. In reply to Mr. Strutt, who referred to the fiscal question, he did not by any means intend that that should be the leading feature of the evening's discussion. The fact that the discussion had drifted in that direction must be attributed to the peculiar times in which we live, and not entirely to what had been said. He agreed with every word Mr. Strutt said about the question of dumping as against the question of competition with low-priced labour on the Continent. As he stated in the paper, they did not fear the low-priced labour on the Continent when there

was fair competition, but they did fear dumping. The *Queen* newspaper contained a whole sheet of advertisements relating to dumped goods. They were constantly told that the people must find other employment. As far as the silk trade was concerned a great many of them had, but it had usually been at the workhouse door. Mr. Coldstream referred to tussah silk, and the possibilities of its further use. At the present time, there were great possibilities in connection with tussah spun silk. It was a yarn which he had only recently become acquainted with, and if trade revived in this country, there would be a very large outlet for it. Mr. Hextall thought that he (the author) had made a mistake in suggesting that a duty of only 5 per cent. should be placed on thrown silk, but he wished to point out that in arranging his suggestions of duties he was guided by the amount of work which it was necessary to put upon the thread in the course of its manufacture. Prior to the old Treaty of 1860, there was no duty on thrown silk, and if he took the present condition of the silk thread industry of the country, we really ought not to put any duty on at all; but he suggested 5 per cent. because he hoped the trade had learned such a lesson from the past ignorance of British producers that they would never again attempt to compete with the Continent or America, on what he called old-fashioned and obsolete ideas. Therefore, if a duty were put on thrown silk, it would encourage throwsters to use the most skilful methods and modern machinery. With regard to duties causing trouble, he could only say that silk manufacturers ought not to fear to face trouble. It was far better to have an industry with trouble than to have no industry at all. It was often quoted against them that there had been trouble in the silk trade in the past; in fact it was stated that the silk trade was full of troubles, and that the weavers were a source of inconvenience to the Government in days gone by. But there were labour troubles in every country in Europe, and also in America. After all said and done, if they knew their business, and were wise in dealing with the workpeople, less trouble would occur with British workpeople than foreign manufacturers would find with their's. He much appreciated Mr. Day's criticisms of the silks exhibited. Mr. Day stated that he admired the 16th century brocades more than any others. He did himself; some of the most beautiful designs were typical of 16th century art; but when one had to manufacture for every sort of person, and every sort of requirement, the manufacturer must be commercial and produce the things that were required, otherwise it would be absolutely impossible to keep a business together. In regard to Mr. Solly's remarks respecting Lord Masham, he did not claim in the paper that Lord Masham was the sole inventor of spun silk; but claimed for him that he improved its manufacture very greatly. He believed that, prior to Lord Masham's invention, spun silk of inferior quality was being produced on the Continent. In conclusion, he wished to say a word about technical instruction, of which the Chairman spoke, and to impress upon everyone connected with the silk trade its absolute importance. He knew it was not the sole thing to be studied. Technical instruction at the present day in connection with the silk trade of this country was as far advanced as anything there was abroad. He had visited all the important centres, and it was his opinion that there was nothing they were lacking in. Every idea, every possible instruction that could be given, was being carried out, but they must not allow themselves to be led away by the idea that simply because technical instruction was preached nothing else was to be done, and that alone could accomplish their salvation. It must be remembered that in most countries where trade had advanced it had always gone in front of technical instruction, and not followed after it. At Manchester, there was a splendid up-to-date technical school, but there was not a single day student in the silk classes, and only a few in the evening. That pointed to the fact that England needed the industry first, and then the technical education would be of immense value. The trade had always had more good technical labour than it was able to employ; what was wanted was the trade, and it was to that end he had written the paper.

CANTOR LECTURES.

THE MINING OF NON-METALLIC MINERALS.

By Bennett H. Brough.

Lecture II.—Delivered November 30th, 1903.

Salts.—Rock salt—Potash salts—Borates—Alums—Nitrates—Phosphates.

From a mining point of view all minerals occurring in nature that are soluble in water may conveniently be classed as Salts. About twenty such minerals are of economic importance, and in some cases are mined in enormous quantities.

Salt.—Salt is one of the most widely distributed of minerals. It is a constituent of sea water. Salt lakes exist in numerous localities, and it occurs in beds in most of the geological formations. Important papers were read before the Society in 1894 by Mr. Thomas Ward,* describing the manufacture of salt in different parts of the world, and in 1889 by Mr. P. L. Simmons,† giving statistics of its production and consumption. Since the date of Mr. Simmons's paper the world's production has

* *Journal of the Society of Arts*, vol. 43, p. 77.

† *Ibid*, vol. 37, p. 249.

almost doubled. In 1901 the world's production of rock salt, evaporated salt, and sea salt, according to returus collected by Sir C. Le Neve Foster, was as follows :—

	Metric tons.	Per cent. of total.
United States	2,612,824	20·1
Russia	1,968,005	15·1
United Kingdom	1,811,670	14·9
Germany	1,563,800	12·1
India	1,120,239	8·7
France	910,350	7·0
Japan	659,118	5·1
Austria Hungary	517,220	4·0
Italy	435,187	3·3
Turkey	203,128	1·5
Venezuela	155,800	1·2
Other countries	907,248	7·0
World's total	12,864,589	100·0

The annual consumption of salt as a condiment is estimated by Mr. F. A. Fürer to be as follows per head of population in the principal countries of the world :—

	lbs.
France	11·4
Italy	13·7
Germany	16·0
Austria	17·0
Russia	18·6
United Kingdom	27·5
United States	33·0

In Germany, careful statistics are kept of the consumption of salt for agricultural and industrial purposes. It amounted in 1901 to 565,517 tons, or 22 lbs. per head of population. Under this category there were used in soda and Glauber salt manufacture, 254,433 tons ; in chemical works, 102,553 tons ; in the metal trades, 21,899 tons ; for cattle food, 109,949 tons, and for manure, 3,441 tons.

There is no country better supplied than England with beds of salt and brine springs. The most important beds are those in Cheshire, where mining has been carried on since the year 1670. At the mouth of the Tees, where salt was discovered in 1862, the beds cover 20 square miles, and each square mile contains 100,000,000 tons of salt. Salt is also extracted at Carrickfergus, in Antrim. Salt is mostly obtained from brine, the quantities of rock salt mined being less than one-tenth of the total output. At Northwich in Cheshire, there are two beds of rock salt of Triassic age, each 84 to 90 feet thick, and separated by 30 feet of marl.

The output of rock salt from mines in 1902, comprised 68,224 tons from Lancashire, 61,440 tons from Cheshire, and 32,529 tons from Antrim. Figures given by Fürer, show that in Cheshire, Durham, Staffordshire, and Worcestershire, there are 55 salt works with 1,316 salt-pans. In 1888, numerous salt works were consolidated by the Salt Union, Ltd. (present capital, £1,400,000). From the bed of rock salt, about 100 feet thick, near Middlesbrough, large quantities are pumped up in the form of brine from deep boreholes. The brine is delivered into a large pond whence it flows into iron evaporating pans, 70 feet long, 24 feet wide and 16 to 20 inches deep, heated by the flame of a coal fire. As table salt, the salt obtained from brine is universally preferred to rock salt. The process employed for manufacturing salt from brine is extremely simple. It consists merely in the evaporation of the water and the collection of the salt that is deposited. Although in England the manufacture of salt has been carried on since the Roman occupation, the process has undergone so little change that the plant in use is not essentially different from that employed 1,400 years ago. Attempts have, however, been made with success to economise fuel. Sir Lowthian Bell, for example, utilises the heat of blast-furnace slag. At the works of Bell Brothers, Ltd., there are also five salt-pans heated by blast-furnace gas. The gas is first used for heating steam boilers and the waste heat is then used for salt evaporation. Owing to their depth below the surface many beds are not mined but are pumped up as brine. At Syracuse, New York, wells are sunk not into the salt bed itself, but into an ancient gravel deposit saturated with brine. The brine is run in a continuous stream into large pans 130 feet in length, and as it evaporates, the salt is deposited on the bottom, and is scraped on to the sloping sides of the pan. In Austria, salt mines were worked in Tyrol in 1280, and even in these operations old workings were found. The salt-clay had almost completely re-filled the old excavations. Modern mining operations have again encountered these old workings, and the objects found render it evident that salt mining was here carried on by the Celts 900 B.C. Few metallic objects have been discovered. On the other hand, numerous wooden articles and remains of skin clothing have been found in good preservation. The prehistoric salt mines at Hallstatt reached depths of as much as 200 yards. The archæo-

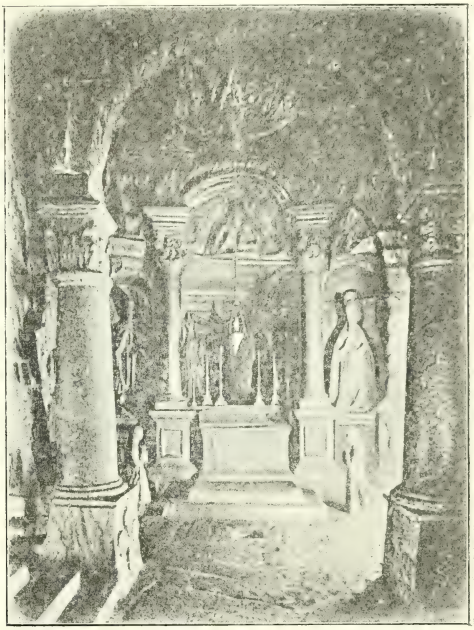
logical remains consist of beechwood that served as handles for copper and bronze axes, a double pick of beechwood, wedges of black serpentine and crowbars of copper and bronze. For supporting the workings larchwood was used. Torches made of pine shavings, and two fur caps and a piece of coarse woollen fabric were also found. Specially noteworthy are two sacks for the transport of salt, preserved in the Vienna Museum. They are 30 inches high and made of raw ox-hide. For carrying the sacks there is a leather strap that passed over one shoulder, and a wooden handle 15 inches long fastened by two straps to the upper part of the sack. With this handle the sack could be held securely when full, and on releasing the handle the contents of the sack could be tipped backwards. A loop was provided for hanging up the sack.

The world-famed salt mines at Wieliczka, near Cracow, have been worked since prehistoric times. The first mention of Wieliczka occurs in a charter granted by King Casimir I. in 1044, but the discovery of the deposits dates back to pre-historic times, although the legend is that Wieliczka has to thank St. Kunigunde for its riches in salt. When Boleslaus the Shameless was betrothed to Kunigunde, daughter of the Hungarian King Bela IV., she expressed the wish to see her land, which suffered from an absolute lack of salt, blessed in its possession. She prayed fervently, and her prayer at last was granted. The wedding ring of this princess which she had cast into a well in Hungary when on a visit to her father, was miraculously found again, during her stay in Wieliczka, in a block of salt. Since 1260 mining has continued with little interruption. In 1638 the mine-surveyor, Martin German, a Swede by birth, made the first plan of the Wieliczka mines. In 1772 the mines passed into the possession of the Austrian Government. A great change in the methods of mining was then made. The lavish gifts of salt to Polish individuals and monasteries were cut down, and systematic mining operations were introduced.

The rock-salt bed is of lower Miocene age. In sinking the shafts, after various beds of clays, sands, marls, and gypsum, unstratified green rock salt was encountered, containing salt masses, and detrital sandstone, limestone and granite in greenish gray clays, and lastly the stratified salt-measures, consisting of beds of salt, clay, and anhydrite. The thickness of the stratified salt-measures opened up amounts to 150 yards. The worked out unstratified green-salt masses form the portion of the mine that have long aroused the amazement of tourists. From the earliest times the mine has been worked by shafts, eight of which are still in use, the deepest, the Kaiser Josef shaft, having a depth of 985 feet. At this shaft in 1860 the first steam-winding engine at these mines was started. During the past century the space excavated for the extraction of salt amounts to 3,000,000 cubic yards, and the length of roadways driven to 115,000 yards.

Ample opportunity is given to enable visitors to see these remarkable mines. The chief

Fig. 5.



St. Anthony's Chapel, Wieliczka Salt Mines.

object of interest shown is the St. Anthony's Chapel (Fig. 5), 25 feet long, 20 feet wide, and $10\frac{3}{4}$ feet high, hewn, complete with altar, statues, and pillars, in the year 1698 out of the solid green rock salt. In the Kaiser Franz chamber there are two pyramids hewn in salt to commemorate the visit of the Emperor in 1817. In the Walczyn Steinhauser chamber, which was excavated in 1743, the ancient method of lowering the miners in slings used to be shown. The visitors ferry across the underground lake of the Crown Prince Rudolf grotto. Lastly the ball-room of the Letow chamber is visited. Other objects of interest are the imposing Michalovice chamber, made

in 1717-1761, which measures 120 feet in height, 60 feet in width, and 90 feet in length, and is illuminated by a chandelier of 200 candles; and the Count Goluchowski railway station, a chamber 170 feet long, 65 feet wide, and 52 feet high, near the main shaft. Owing to the necessity for supporting the workings, these ancient excavations will all in time have to be filled in, and future visitors to this ancient mining town will hardly realise its ancient glories.

The Alpine salt mines of Aussee, Hallstatt, and Ischl in the Austrian Salzkammergut, of Hallen in Salzburg, Hall in Tyrol, and Berchtesgaden in Upper Bavaria, are situated amidst the magnificent mountain scenery so familiar to tourists. The deposits are very similar and in each case the salt is obtained from the impure material by an artificial washing out. The Berchtesgaden mines, which are visited by 20,000 tourists annually, date back to the twelfth century, and their history can be followed from the commemoration marble tablets put up in the mines from 1514 to the present time. One of these, dated 1726, can be seen in the illuminated grotto (Fig. 6) of transparent rock salt, which is the greatest attraction for visitors.

Fig. 6.

Illuminated Grotto, Berchtesgaden Salt Mines.

It is a curious fact that from time to time fire-damp explosions take place in salt mines. Indeed, the first fire-damp explosion recorded occurred at a salt mine at Hallstadt, in Austria, on September 9th, 1664, twenty years before what is generally supposed to be the first historical evidence of the presence of fire-damp, given by Robert Plot in his "Natural History of Staffordshire." In several localities, notably at Stassfurt and at Wieliczka, the salt contains bubbles filled with the various compressed gases which, when the salt is dissolved, give rise to a crackling noise. Liquid inclusions in rock salt are extremely frequent. Some are visible to the naked eye, others are microscopic. The enclosed material is usually a hydrocarbon. Combustible gas was evolved in large quantities from a fissure in the marl in the rock salt at the Szlatina mine, Hungary, and was used for lighting the workings. A serious explosion occurred here on August 28th, 1896. Similar emanations of gas were utilised at Zugo, in Transylvania, and at the Bex salt mines in the Canton of Vaud, Switzerland. Fire-damp has been used for lighting the workings, being received from the fissures in cast-iron pipes. Such occurrences are fairly frequent in the Wieliczka mines. An outbust of gas in 1828 burned for some weeks with a flame 1½ feet in diameter, and the ancient records make frequent mention of these outbursts. The earliest record occurs in a poem written by Adam Schröter in 1564, entitled "Salinarum Vielicensium descriptio." There is also preserved at the mines an old plan made in 1638 to 1648, on which fiery workings are duly marked. It is only recently that the firing of the gas has been prohibited. At the present time stress is laid upon good ventilation and suitable illumination. Hand-driven fans are employed, and the air current is conveyed through 4½-inch zinc pipes. Canvas pipes have recently been successfully introduced. Open lamps with vegetable oil are used, electric lamps being kept in reserve in case of explosions. Mueseler safety lamps have also recently been adopted in fiery working places. The miners, who are extremely conservative, object to safety lamps, as they are much heavier than ordinary oil lamps. Advance bore-holes are now driven to detect the occurrence of gas accumulations. With the Elliot rock drill three men can easily bore a hole 50 yards in depth, safety lamps being used during the operation for lighting.

The rock salt deposits of Hungary, to which I have referred on a previous occasion,* are second to none in Europe, and are apparently inexhaustible, the most important being in the Marmaros and in Transylvania. To the former belong the Szlatina salt mines, where the quantity of salt available is estimated at 18,000,000 tons, and to the latter, the Deésakna mines, where the quantity available is 800,000,000 tons. Besides these there are salt beds in many other parts of Hungary.

* *Journal of the Society of Arts*, vol. 36. p. 266.

For drying and packing the salt many ingenious inventions have been proposed. A fertile inventor in this field was the late Carl von Balzberg. The packing of salt in the tropics is a subject of such importance that the Government of the Dutch Indies was induced to offer a valuable prize for the best suggestion. Mr. von Balzberg, who was director of the Ischl Salt Works, was induced to compete by the fact that he was at the time engaged on a thorough investigation of the subject of compressing salt into briquettes for the Austrian works, and he concluded that this procedure might be recommended as the best method of packing. For this suggestion he received the prize. He employed a hydraulic press working up to a pressure of 200 atmospheres. By this pressure the salt is reduced to half the volume of the loose salt, so that great advantages in shipping and storing are presented. The Ischl Salt Mines are increasing their briquette plant, and the Aussee Salt Mines are installing plant to turn out in 24 hours 40,000 to 45,000 salt briquettes weighing 2 lbs. each, and containing not more than 1 per cent. of moisture.

It is not European salt that supplies the Soudan, the Niger district, Lake Tschad, and the Belgian Congo, but salt in blocks derived from Sahara. It is transported in the state of blocks weighing about 50 lbs. All travellers are familiar with these blocks of salt, which form one of the principal objects of Soudan commerce. This crude salt, impure and coloured by foreign matter, presents the advantage that it is solid, convenient to handle, and weather resisting. From the place of production to their destination these blocks of salt have to travel enormous distances, as much as 1,200 miles. The expenses of so long a journey, aggravated by the perils to which caravans are subjected, explains the increase in price as the distance from the starting point becomes greater. Salt which costs 6d. per lb. at Timbuctoo, fetches 1s. on the Upper Niger, and 2s. at Kong. A Marseilles company is putting on the market very pure salt in the form of compact blocks presenting the appearance and polish of white marble. The blocks have the same dimensions as the natural product of the Sahara. The latter is obtained from three principal points: the Idgil deposit that supplies Western Africa, the Taodenite deposit that supplies Sahal, the Niger and the Congo; and the Bilma deposit that supplies East Africa and Lake Tschad. These deposits have been formed by the evaporation of inland salt lakes. The origin of such inland salt lakes is a subject of constant controversy. This has, for example, been the case with the salt lake of Larnac in Cyprus, a deposit of considerable economic importance. As the lake is separated from the sea by a barrier, older writers considered that the salt was not derived from the sea, but from the soil. Careful levelling and boreholes have proved that the salt was not derived from a rock salt bed, but permeated from the sea through a porous conglomerate. When a stream containing salts in solution flows into a lake with no outlet, such as the Great Salt Lake in Utah, or the Dead Sea, the water is evaporated while the impurities remain. At the Great Salt Lake, the Inland Salt Company's workings are situated near Garfield Beech. The water is pumped from the lake into a series of ponds which cover over a thousand acres. Pumping ceases in August, and a layer of salt seven inches deep is found to be deposited from 49 inches of lake water. The yield of salt is at the rate of 150 tons per inch depth per acre.

In Southern Europe and in tropical countries, the heat of the sun is utilised to evaporate salt water in shallow pools. The extraction of salt by evaporation from sea water, can best be seen in the Trapani district of Sicily, where the industry dates back to 1507. Forty-five salt works now occupy nearly the whole shore up to the gates of Marsala. Though the process of obtaining the salt is very primitive, the yield is abundant on account of the purity of the sea-water and the settled weather in summer. The average production is about 200,000 tons a year. Practically the whole area of a salt works is occupied by evaporating pans. The preparation of the water is constantly cared for throughout the year. It is passed through a succession of pans, evaporating as it goes until it contains 30 to 35 per cent. of salt, when it is ready for final evaporation at the proper season, until which it is kept stored. The pans are about 90 feet square and 15 inches deep, with a hard bottom of sand. The water is brought from the sea to the pans by windmills. Dry, clear weather and a light breeze give the best conditions for making salt. When the pan are dried up, the salt is collected in small heaps and left to dry for 24 hours. Then it is removed from the pan and piled up in a rectangular heap, which is covered with tiles to keep off rain and dust. Each of these heaps contains about 300 tons of salt, and they are all close to channels where lighters moor to load the salt and then

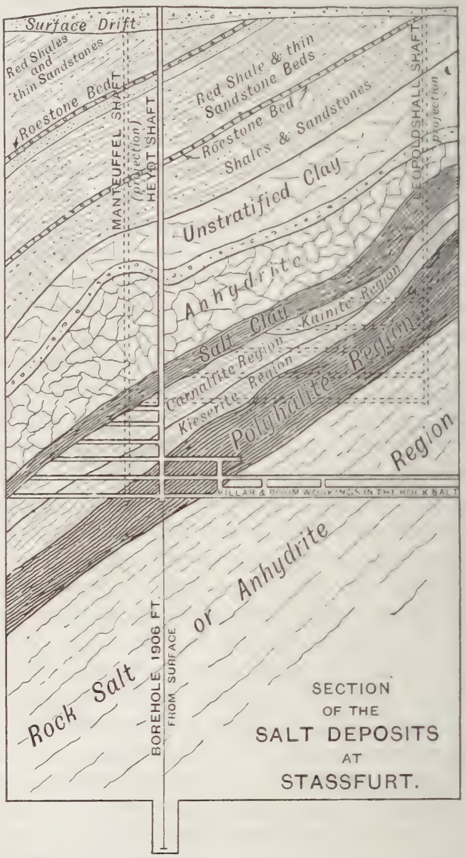
convey it to the ships. A pan will yield salt three, or even five times in a season, which closes with the coming of rain and damp nights in the autumn. The salt is of three qualities, fine, coarse, and ground marine salt, the last being only used locally and never exported. The salt is exported to Scandinavia, Canada, and the United States, and to all places where there is a large industry in salt fish. A similar method of extraction by solar evaporation is employed near Karachi in India.

The search for deep-seated salt beds is constantly being prosecuted. In Germany numerous boreholes have recently been put down for salt. Some of these have been carried out with great expedition. At Kaiseroda, for example, a borehole begun on January 2nd, 1894, struck salt at a depth of 525 feet, on January 15th. The greatest depth attained in boring for salt was 4,650 feet, at Salzdetfurt, in Hanover. In Western China boring for brine is actively carried on. The boreholes are 2,200 to 3,300 feet deep, and are sunk by percussion with all the machinery made of bamboo.

Potash Salts.—With rock salt, in certain cases, a number of other salts occur to which brief reference may be made. Among these the natural potash salts are the most important. The rich stores of these salts, of which North Germany possesses the monopoly, were first utilised in 1861, when mining operations were begun at Stassfurt. The production and consumption increased so rapidly, that in 1901 the production of kainite and other potassium salts amounted to 3,534,895 tons. The salts are used for manufacturing purposes and as manures for crops and garden produce. The deposits are of Triassic age, and cover a vast area, the beds being usually at a considerable depth below the surface. Both the production and prices are regulated by a syndicate. The working of a commercial trust is well illustrated by the operations of this Potash Syndicate, one object of which is to supply German consumers with a cheap article, while much higher prices are charged to foreigners.

The salt industry of Stassfurt is a very old one, dating back to legendary times. The oldest existing title is dated 1461. The development of the salt mines owed much to Anna von Schladen, who was abbess of the convent at Hecklingen, and contributed funds in 1452 for the sinking of an important brine well which was, for a long time, the chief source of supply. A portrait of the abbess is still preserved at the mines. In 1797 the wells were purchased by the Prussian Government who, in 1839, began boring with a view to discover the bed from which the brine was obtained. In 1851 the boring, which had reached a depth of 1,906 feet, was given up, salt having been struck at a depth of 850 feet. In 1852 the first two shafts were begun, and in 1857 salt was first mined at a depth of 1,100 feet. In 1860 the potash salts, which had hitherto been thrown aside as

FIG. 7.

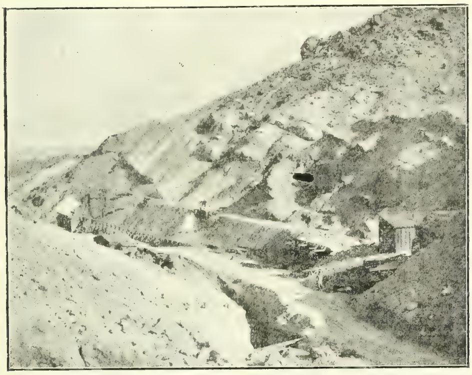


SECTION OF THE SALT DEPOSITS AT STASSFURT.

impure salt, were exploited. A section of the strata passed through by the two shafts is shown in Fig. 7. The bottom of the bed of rock salt was not reached. The beds above consist, in ascending order, of polyhalite (sulphate of potassium, magnesium and lime), kieserite (sulphate of magnesium), carnallite (chloride of potassium and magnesium), and kainite (a secondary formation caused by action of water on kieserite and carnallite). The upper bed of rock salt, resting on anhy-

drite, is also of secondary formation. Altogether some 16 different minerals occur in the Stassfurt deposits, but only the carnallite, kainite, kieserite, and salt are of commercial value. In May, 1900, the Achenbach shaft, 1,280 feet deep, was flooded, and it became necessary to supply the chemical works at this shaft with crude potash salts from other mines. A railway at the surface to transport the material was not practicable, and the number of public roads to be crossed rendered a wire ropeway too costly. An underground railway was therefore constructed, on which electric locomotives are used. Altogether the mechanical equipment of the Stassfurt mines is of the highest order. Siemens and Halske's electric drills are used for boring in the salt. Potash salts have also been raised since 1887,

FIG. 8.



BORAX MINE, NEAR DAGGETT, CALIFORNIA.

at the Hercynia mine at Vienenburg, in Brunswick.

Borates.—With the potash salts at Stassfurt boracite (borate of magnesium), occurs. A second boric acid compound, natural borax (borate of sodium), occurs in vast quantities in the so-called borax lakes of California and Thibet. Borax occurs in the Death Valley region in a regular stratum interbedded with semi-indurated sands and clays. The mines at Borate are the chief producers of borax and boracic acid in the United States. At this place, 12 miles north of Daggett, in the old Calico mining district, calcium borate occurs as a bedded deposit (Fig. 8) 5 to 30 feet in thickness, interstratified in sedimentary strata. There are two outcrops, either on parallel beds or on one bed that has been closely folded. The world's production of borates in 1901 was as follows:—

	Metric tons.
United States (calcium borate)	21,080
Chili (calcium borate)	11,455
Turkey (calcium borate)	9,000
Peru (calcium borate)	7,080
Bolivia (calcium borate)	3,065
Italy (boric acid)	2,558
Germany (pure boracite)	164

The uses of borax have been fully dealt with in a paper by Mr. E. L. Fleming.* In 1899 various borate mines were consolidated under the name of Borax Consolidated, Limited (capital £1,400,000).

Alums.—Alum was formerly made from natural salts, but at the present time cryolite and bauxite have taken their place. Pickeringite (magnesium alum) is found in the greatest abundance in the rainless district of Tarapaca, Chili. Alum-stone or alunite (hydrated sulphate of aluminium and potassium) occurs in fissures in felspathic rocks at the Tolfa near Civita Vecchia, and in New South Wales and many localities. Most of the alum made in England was formerly obtained from alum shale and similar substances which occur at Whitby in Yorkshire, at Campsie in Scotland, in Bohemia, and elsewhere. The production of alum shale in England in 1902 was 5,664 tons, valued at £708. The Italian production of alunite in 1901 amounted to 4,900 tons, and that of Australia to 3,146 tons.

Brief mention may here be made of the natural sodium carbonates; natural soda and trona found in dry lakes in Arizona, Egypt, and other arid regions. In the same way the natural sodium sulphates, Glauber salt and thenardite are met with. The most extensive deposits are at Tiflis and Baku, the Russian production being about 5,000 tons annually.

The double chloride of aluminium and sodium, known as cryolite, presents the remarkable peculiarity of occurring in large masses in Greenland without having been met with elsewhere. It has been mined opencast since 1857, and utilised for the manufacture of aluminium and alum. It occurs in a vein 150 feet wide, in granite. The quantity obtained from Ivigtut in 1901 was 7,997 tons.

Nitrates.—Since the year 1850 an important industry has developed in the preparation of mineral fertilisers. The raw materials for this industry are the potash salts to which reference has been made, Chili nitrate, guano, and natural phosphates. The phosphoric acid contained in many iron ores is also utilised in the form of basic slag obtained by the basic

* *Journal of the Society of Arts*, vol. 39, p. 523.

process of steel making. Nitrate of potassium is formed whenever animal or vegetable remains come in contact with rocks that weather easily. In India, in 1901, the production was 11,524 tons. In 1821, on the arid west coast of South America great deposits of nitrate of sodium were discovered. They occur chiefly on the Rio Loa, near Caracoles and Taltal. The raw material, known as *caliche*, is converted into pure nitrate by leaching with water and a subsequent process of crystallisation. The crude nitrate is found in beds 6 inches to 12 feet in thickness under a covering of conglomerate. In 1901 the world's consumption of Chilian nitrate amounted to 1,375,400 tons, of which 1,162,400 tons were used in Europe. In 1901 exports of nitre from Chili reached the record value of 581,879,965 dollars. Of the total, 34·10 per cent. went to Great Britain, 29·59 per cent. in Germany, 14·52 per cent. to the United States, and 9·30 per cent. to France. A large amount of British capital is invested in the nitrate fields. A combination of nitrate producers came into force in 1901, and is intended to cover a period of five years. The effect was to cause an advance of 40 per cent. in the price. The lowest price in London was in 1898, when the average was 7s. 4½d. In 1902 the average was 9s. per quintal. The following is a list of the chief nitrate companies before the public, together with the amounts of their capital :—

	Total Capital. £
Alianza	1,000,000
Amelia	391,000
Anglo-Chilian	1,034,900
Lagunas Nitrate	900,000
Lagunas Syndicate	1,160,000
Lautaro	598,000
Liverpool	110,000
London	160,000
New Tamarugal	545,130
Rosario	998,500
Salar del Carmen	153,500
San Jorge	300,000
San Pablo	160,000
San Sebastian	143,750
Santa Rita	113,800
Santiago	269,600

Phosphates.—As raw material for the manufacture of super-phosphate, the natural phosphate of lime is used. It is met with in two varieties, crystallised as apatite or in the form of a rock as phosphorite. The former occurs in large quantities in the south of Norway and in the Spanish provinces of Estremadura, whilst phosphorite occurs in Florida. In Great Britain, foreign competition has interfered with the phosphate industry. The mineral is obtained from beds in the cretaceous rocks in Bedfordshire and Cambridgeshire. In 1901 the world's production of phosphates comprised :—

	Metric tons.
United States	1,507,958
France	535,676
Algeria	265,000
Belgium	215,000
Tunis	172,375
Christmas Island	37,000
Russia	25,663
Aruba (Dutch West Indies)	10,413
Spain	4,220
Canada	937
Norway	300
United Kingdom	80

The well-known deposits at Redonda in the Leeward Islands (aluminium phosphate), were not worked in 1901.

The growing importance of the phosphate industry of Northern Africa is remarkable. At Gafsa, where most of the Tunisian phosphate is obtained, the mineral was not discovered until 1885. Since the concession for working it was granted in 1896, the French have constructed a railway 28½ miles long from the oasis of Gafsa to the mines, as well as one 15½ miles from the port of Sfax to the mine, and it is expected that the output for 1903 will be 300,000 tons. The phosphate beds occur in rocks of lower Eocene age. The principal bed now being worked is 13 feet thick, and contains 59 to 61 per cent. of tribasic phosphate of lime, and is, therefore, extremely rich. This phosphate placed on the trucks at the mines does not cost more than 4s. a ton. The production of phosphate in Tunis continues to increase. In 1899 the output was 63,209 tons, whilst in 1902 it was 263,493 tons.

Of the American phosphate deposits, those of Canada, South Carolina, and Florida are of chief importance. The existence of nodular amorphous phosphate deposits in Florida was known many years ago, but they remained unworked until 1888. There are four classes of phosphates, the hard rock, the soft rock, the land pebble and the river pebble, and the work of exploration has now extended all over Florida in each of the varieties of deposits. In several of the mines the deposits are of very great size. At Anthony, for example, there is a remarkable deposit of drift phosphate, one cubic yard yielding 500 lbs. of washed material averaging 76 per cent. of phosphate of lime. The boulder material is worked by

quarrying after the top soil has been removed. The thickness of the boulder deposits is very variable. In one case it was 50 feet. Sometimes the difficulties of dealing with the overburden of soil are obviated by the use of a chain conveyor. At some of the larger mines complicated dressing plant is employed for washing, screening, and drying the mineral. In mining the hard rock or high grade boulder deposits, care has to be taken to select the different qualities of mineral. This is the case notably in extracting boulder material from clay and sand in Citrus country. Unlike the boulder deposits, the pebble or drift deposits are marked by great regularity. The chief centre for pebble phosphates in Florida is Peace River. The deposits are worked by a centrifugal steam suction pump placed on a barge. The mixture of sand and phosphate drawn up is brought into revolving screens, whence the sand is washed back into the river. The cleaned pebbles are discharged at the rate of 12 tons per hour, and are conveyed in boats to the dressing floor, where they are taken up by an elevator to a drying room, dried by hot air, screened once more, and are then ready for market. The total cost of raising, dressing and loading varies from 2s. to 8s. per ton. Geologically the rock phosphates appear to be the deeply eroded remnant of the phosphatised surface of the Middle Tertiary limestone, the conglomerate deposits are of Miocene age, whilst the river drift deposits are of more recent age than the Pleistocene sands that cover the entire peninsula. In South Carolina the celebrated phosphate beds are of great extent. The total cost of production of land phosphate is 14s. per ton. The mineral occurs in nodules in a bed 8 inches thick, and is thought to be of post-Pliocene age. In Canada the phosphate occurs in rocks of Laurentian age in Quebec and in Ontario. The Canadian apatites cannot be mined and shipped at a profit unless they contain 75 to 90 per cent. of the pure mineral. The method of working is in many cases very primitive. In some of the larger mines, however, proper development work has been undertaken with a view to lasting profits rather than immediate gains. In Sweden and Norway veins of apatite associated with iron ore are met with, the deposits containing as much as 60 per cent. of apatite. I have described in a paper read before the Society in 1897 * the utilisation of this apatite at Lulea, in the preparation of Wiborgh phosphate, a highly valuable fertiliser of great solubility. In Picardy phosphates of lime occur in the form of phosphatised chalk and of phosphatic sand. The phosphatised chalk occurs in ellipsoidal basins varying in diameter from 300 to 10,000 feet, and at the same time the deposits are lenticular. At the base a conglomerate of chalk nodules rich in phosphate usually occurs. The genesis of the phosphatic chalk is explained by Mr. J. Gosselet in the following manner:—A pause in the sedimentation of the white chalk was followed by a penetration of its surface by a phosphate of lime solution, which hardened it and altered it into a richly phosphatised chalk. The hardened surface emerged, and a crust of phosphate was deposited on it, a breccia being formed at the expense of the hard bed. The encrusting process continued, and the crust was perforated by large boring organisms. Much of the hard rock was destroyed and re-deposited. A deposition of normal phospatic chalk followed. The phospatic sand was no doubt formed by the chemical action of rain water, charged with carbonic acid, on the phosphatic chalk. It is made up almost entirely of small grains of phosphate of lime, and forms a layer on the walls of pockets in the phosphatic chalk. The pockets vary in depth up to 33 feet. These pockets at Beauval, Somme, present a striking appearance, as also do the workings of phosphatic chalk at Hardivilliers, Breteuil, Oise, and of phosphatic sand at Harquicourt, Aisne.

The origin of phosphates has been much debated. The general opinion is that there are three classes of mineral phosphates, the first being the apatite found in the older crystalline rocks, which are regarded as of primordial origin; the second are represented by the phosphorites of Estremadura, which are essentially deposits from mineral waters; whilst the third or concretionary phosphates are of animal origin, as is shown by the presence of organic remains and of nitrogenous organic matter and nitrates. Mr. J. J. H. Teall, who has devoted much attention to the natural history of phosphatic deposits, is of opinion that calcium phosphate may be formed by the accumulation of animal remains by the replacement of carbonic acid by phosphoric acid through the action of solution arising from the leaching of guano, or the decomposition of animal matter, by direct deposition from solutions of calcium phosphate, and by chemical precipitation due to the interaction of solutions

* *Journal of the Society of Arts*, vol. 46, p. 69.

containing ammonium phosphate and calcium bicarbonate.

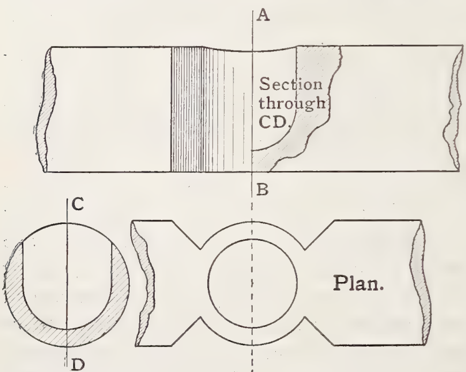
These few remarks will, I trust, give some idea of the character of the phosphates worked. The importance of a knowledge of the world's phosphate resources is manifest when we learn that the quantity of phosphoric acid annually removed from the soil of the United States alone by the cultivation of cereals amounts to 2,714,584,473 lbs., or 19 lbs. per acre. A similar estimate for the hay crop is 12½ lbs.

Correspondence.

SMALL FURNACES FOR JEWELLERS' WORK, ART CASTING, &c.

I am very sorry I was unable to be present when Mr. Cunynghame read his most interesting paper. I have been for some time engaged in researches for which the obtainment of high temperature was a necessity, and should have liked to have made a few remarks on one or two points. Perhaps I may state them in writing, not mentioning those which have been already discussed.

I am not aware of the quantity of metal Mr. Cunynghame found sufficient to melt at one time. In the muffles he mentioned at the beginning of his paper—one inch or two in width—it cannot be large. Perhaps for such a limited requirement, the kind of furnace I have been now using for several months will give a simple and correct solution of the question of small furnaces for jeweller's work, art casting, &c.



Section through AB. (end view.)

It is a very simple form of resistance electric furnace, that can be made at very little cost anywhere an alternating electric supply, such as used for lighting purposes, is available. It was suggested to me by Mr. C. H. Wright, of Crompton and Co., and I found it answer beyond all expectations.

It is made by taking a piece of arc lamp carbon and boring in it transversally a cavity in which a small fire-clay or porcelain crucible is dropped, and so is submitted to a regular and uniform heating when a current, passing in the carbon piece from one end to the other, brings to incandescence the thin places left in the carbon as wall to the cavity, places which have a very high resistance.

I have used carbons 1¾ inch diameter. In such a carbon a hole 1¼ inch diameter and 1¼ inch deep can be made, with moderate skill, without much risk of breaking. The crucible that can be put in this hole can contain ten or twelve cubic centimetres of metal. The current at about 50 periods per second, 100 volts, was transformed down to 4 volts, about 200 amperes being passed through the carbon. This can be easily controlled by adjusting the primary current. In three or four minutes a cubic centimetre of copper is melted. This quantity was sufficient for my purpose; but I have no doubt that a full crucible could be obtained in very little time, say ten minutes, for once the fusion was started, an armature copper bar ¼ inch square, on being put in the crucible, melted as quickly as it was pushed in the molten metal. The cost would be about three farthings.

The apparatus is fixed on a slab of slate supported on four wooden dices, the whole being placed on the table with the interposition of a sheet of iron. The carbon is found to wear out rapidly, but by surrounding it with a tube of asbestos so as to exclude the air—leaving an opening for inserting the crucible—this is obviated, and the radiation prevented. The current is brought in and out by thimbles, in which the carbon is fixed by clamping screws.

I believe this apparatus could be made of a larger size, at comparatively little cost. I have been able to melt steel with it, as the end of a steel rod used for manipulation of the hot crucible showed. It causes no annoyance to the draughtswoman who works sometimes all day, at only two or three feet away, on the same table.

I should also like to say a few words about the precautions mentioned in the paper with regard to fire-clay muffle making. I make my crucibles myself, with a greyish clay I get at the gas works, the origin of which I have been unable to ascertain as yet. I merely knead it well and shape it to the required size. The crucibles are then heated on an electric plate for one hour or so, and can be used at once for as high a temperature as that of melting copper. After having been submitted to that temperature, the clay is so hard that, when the metal is solid, if it is wished to obtain the ingot by breaking the crucible, it is very difficult, although the thickness is but 1-16th to 3-32nd of an inch.

Lastly, I should like to state that I have worked a long time with the Swedish paraffin lamp, and, contrarily to Mr. C. V. Boys's experience, I never found it to give a smell when properly managed, even with the large sizes. When the flame is blown out, the cock D regulating the vapour jet, must be closed at once. If, as in the small types, there is no such cock, then the pressure must be released at once by a side cock provided for the purpose. If only a little

time has elapsed—up to a quarter of a minute—the lamp can be relighted without having to recur to the tedious process of heating again the vapourising chamber.

M. E. J. GHEURY.

84, London-road, Chelmsford, Dec. 13th, 1903.

Mr. H. H. CUNYNGHAME, C.B., writes:—The furnaces shown by me were of two kinds, one for melting metals, the other for muffles for enamelling or metallurgical work. Although of small size, the largest melting furnace shown having a crucible about 5 inches high, and the largest muffle being only about $5\frac{1}{2}$ inches wide, they are capable of being made much larger.

Mr. Boys said that the Swedish lamp would smell when you blew the light out and let the vapour escape into the room—a thing that would never happen, and which is at once rectified either by applying a light or loosening the pressure valve.

The energy used to work the proposed electric furnace seems small, but would I should say be prohibitive on a large scale as compared with paraffin. On this, however, I offer no opinion.

THE SCIENCE OF TAXATION AND BUSINESS.

In compliance with the request of Sir Robert Giffen that I should furnish chapter and verse for the quotations I made last night from Adam Smith's "Wealth of Nations," I send the quotations, which are to be found in Book IV., chap. ii. The first portion of the chapter is devoted to an argument against "Monopolies and absolute prohibitions in manufactures" as well as in corn, and to high duties which amount to a prohibition, but there is not a word in it which favours the free importation of manufactures. After discussing the question of monopolies, prohibitions, &c., the chapter approaches the subject of free import, and then the whole of the argument proceeds to show that the free import of agricultural produce is not open to those objections to which the free import of manufactures is exposed, and that the cost and difficulties of transport will always be a sufficient protection to the British farmer from serious competition by the foreigner. He says:—

"Manufactures, those of the finer kind especially, are more easily transported from one country to another than corn or cattle . . . . . In manufactures a very small advantage will enable foreigners to undersell our own workmen, even in the home market. It will require a very great one to enable them to do so in the rude produce of the soil. If the free importation of foreign manufactures were permitted several of the home manufactures would probably suffer, and some of them, perhaps, go to ruin altogether, and a considerable part of the stock and industry at present employed in them would be forced to find out some other employment. But the freest importation of the rude produce of the soil could have no such effect on the agriculture of the country."

The chapter then goes on to explain the reason of this:—"If the importation of foreign cattle, for example, were made ever so free, so few would be imported that the grazing trade of Great Britain would be very little affected by it." It then dilates on the difficulties of transport, and takes up the question of the importation of salted meat:—"The freest importation of salt provisions could have as little effect upon the interests of the graziers of Great Britain as that of live cattle."

Then the chapter approaches the question of the import of wheat:—"Even the free importation of foreign corn could very little affect the interest of the farmers of Great Britain.... The small quantity of foreign corn imported, even in times of the greatest scarcity, may satisfy our farmers that they can have nothing to fear from the freest importation. The average quantity imported, one year with another, amounts only ...... to 23,728 quarters of all sorts of grain ...... so it is probable that, one year with another, less would be imported than at present."

It is not surprising that Adam Smith should have failed to foresee the marvellous progress of inventions which have entirely altered the conditions of transport, but there can be no doubt that he would have predicted the ruin which has unfortunately befallen our agriculture if he could have had any conception that the actual imports would rise to 1,800 times the amount on which he based his conclusion, that they would very "*little affect the interests of the farmers of Great Britain.*"

GUILFORD L. MOLESWORTH.

December 17, 1903.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock:—

JANUARY 20.—"Organ Design." By THOMAS CASSON.

JANUARY 27.—"Ice Breakers and their Services." By ARTHUR GULSTON.

FEBRUARY 3.—"Steam Motors." By THOMAS CLARKSON, M.I.Mech.E. LIEUT.-COL. H. C. L. HOLDEN, R.A., F.R.S., will preside.

FEBRUARY 10.—"Thermit." By CHARLES VERNON BOYS, F.R.S.

FEBRUARY 24.—"Mahogany and other Fancy Woods available for Constructive and Decorative Purposes." By FRANK TIFFANY.

Dates to be hereafter announced:—

"Lessons to be Learnt from the Fire Brigade Appliances at the late International Fire Exhibition." By EDWIN O. SACHS.

"Artificial and other Building Stones." By L. P. FORD.

"Early Painting in Miniature." By RICHARD R. HOLMES, C.V.O.

"Mechanical Piano Players." By J. W. COWARD.

"Agricultural Education." By J. C. MEDD.

"Garden Cities in their relation to Industries and Agriculture." By A. R. SENNETT.

"Motor Cars for popular use." By MERVYN O'GORMAN, M.Inst.E.E.

INDIAN SECTION.

Thursday Afternoons, at 4.30 o'clock :—

JANUARY 14.—"The Presidency of Bombay." By SIR WILLIAM LEE-WARNER, K.C.S.I., Member of Council. The RIGHT HON. ST. JOHN BRODRICK, M.P., Secretary of State for India, will preside.

FEBRUARY 11.—"Our Commercial Relations with Afghanistan." By COLONEL SIR THOMAS HUNGERFORD HOLDICH, R.E., K.C.M.G., K.C.I.E., C.B., Member of Council. The Right Hon. SIR J. WEST RIDGEWAY, G.C.M.G., K.C.B., K.C.I.E., will preside.

MARCH 10.—"China Grass: its Past, Present, and Future." By FRANK BIRDWOOD, B.A.

APRIL 28.—"Industrial Activity in Calcutta." By FREDERICK GROVER, A.M.Inst.C.E., M.I.M.E.

MAY 12.—"British-Grown Tea." By A. G. STANTON.

TUESDAY, MAY 31.—"The Economic and Industrial Progress and Condition of India." By J. E. O'CONOR, C.I.E., late Director-General of Statistics, India.

COLONIAL SECTION.

Tuesday afternoons, at 4.30 o'clock :—

FEBRUARY 2.—The Biology of Federation." By the Hon. SIR JOHN ALEXANDER COCKBURN, K.C.M.G.

MARCH 1.—"Nigeria." By LADY LUGARD (Miss Flora L. Shaw). The DUKE OF MARLBOROUGH, K.G., Under-Secretary of State for the Colonies, will preside.

APRIL 12.—"The Regeneration of South Africa." By BEN. H. MORGAN.

MAY 3.—"Canada and Great Britain." By W. L. GRIFFITH.

APPLIED ART SECTION.

Tuesdays, at 4.30 or 8 o'clock :—

JANUARY 19, 8 p.m.—"Celtic Ornament." By GEORGE COFFEY.

FEBRUARY 16.—

MARCH 15, 4.30 p.m.—"Recent Developments in Devonshire Lace-making." By ALAN S. COLE, C.B.

APRIL 19.—"The Sentiment of Decoration." By ALFRED EAST, A.R.A.

MAY 17.—"Pewter." By LASENBY LIBERTY. SIR GEORGE BIRDWOOD, K.C.I.E., C.S.I., will preside.

Mr. Carmichael Thomas, Treasurer of the Society, has invited the Section to visit the new works of the *Graphic* newspaper, in Whitefriars, at the end of February, on an evening to be hereafter fixed. Due notice of this date will be given in the *Journal*.

CANTOR LECTURES.

Monday evenings, at 8 o'clock :—

J. LEWKOWITSCH, PhD., M.A., F.I.C., "Oil and Fats—their Uses and Applications." Four Lectures.

LECTURE I.—JANUARY 25.—Extent of the Oil and Fat Industries—Sources of Supply—Raw Materials—Modern Methods of Manufacture.

LECTURE II.—FEBRUARY 1.—Methods of Refining—Bleaching—Demargarinating Processes—The Industry of Edible Oils and Fats—Butter Substitutes—Lard Substitutes—Chocolate Fats.

LECTURE III.—FEBRUARY 8.—Burning Oils—Paint Oils—Lubricating Oils—Blown Oils—Boiled Oils—Varnish Industry—Linoleum Industry—Vulcanised Oils—Turkey red Oils—Modern Theory of Hydrolysis of Fats.

LECTURE IV.—FEBRUARY 15.—Modern Processes of Saponification—Candle Industry—Soap Industry—Manufacture of Glycerine—Recovery of Glycerine from Soap Lyes.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, JAN. 4...Chemical Industry (London Section), Burlington-house, W., 8 p.m. 1. Dr. Chikashigé, "The Defects of Uncarburetted Water Gas as Fuel for Laboratory Use." 2. Mr. B. F. Howard, "The Rapid Estimation of Mercury by means of Hypophosphorous Acid." 3. Mr. Arthur Marshall, "The Determination of Moisture in Nitroglycerine Explosives."

London Institution, Finsbury-circus, E.C., 4 p.m. (Juvenile Lecture.) Dr. W. Hampson, "Ice."

TUESDAY, JAN. 5..Royal Institution, Albemarle-street, W., 3 p.m. (Juvenile Lecture.) Prof. Ray Lankester, "Extinct Animals." (Lecture IV.)

WEDNESDAY, JAN. 6...SOCIETY OF ARTS, John-street, Adelphi, W.C., 5 p.m. (Juvenile Lecture.) Mr. Eric Stuart Bruce, "The Navigation of the Air." (Lecture I.)

London Institution, Finsbury-circus, E.C., 4 p.m. (Juvenile Lecture.) Dr. W. Hampson, "Water."

THURSDAY, JAN. 7...Royal, Institution, Albemarle-street, W., 3 p.m. (Juvenile Lecture.) Prof. Ray Lankester, "Extinct Animals." (Lecture V.)

Civil and Mechanical Engineers, Caxton-hall, Westinster, S.W., 8 p.m. Dr. S. Rideal, "Some Selections of Chamber Bacteriology."

FRIDAY, JAN. 8...London Institution, Finsbury-circus, E.C., 4 p.m. (Juvenile Lecture.) Dr. W. Hampson, "Steam."

Architectural Association, 9, Conduit-street, W., $7\frac{1}{2}$ p.m. Mr. Hugh Stannus, "Egyptian Architecture."

Astronomical, Burlington-house, W., 5 p.m.

SATURDAY, JAN. 9...Royal Institution, Albemarle-street, W., 3 p.m. (Juvenile Lecture.) Prof. Ray Lankester, "Extinct Animals." (Lecture VI.)

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FRIDAY, JANUARY 8, 1904.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

NEXT WEEK.

Wednesday, January 13, 5 p.m. (Juvenile Lectures.) Eric Stuart Bruce, M.A., "Navigation of the Air." (Lecture II.—Airships, Kites, and Flying Machines.)

Thursday, January 14, 4.30 p.m. (Indian Section.) Sir William Lee-Warner, K.C.S.I., "The Presidency of Bombay."

Further details of the Society's meetings will be found at the end of this number.

JUVENILE LECTURES.

On Wednesday afternoon, January 6th, Mr. Eric Stuart Bruce, M.A., delivered the first lecture of his course, addressed to a juvenile audience, on "The Navigation of the Air."

Balloons and Parachutes formed the special subject of this lecture.

The matter that is visible to us, such as earth and water, impresses itself most on our brain, yet what we call air, or the practically invisible ocean in which we move, is also material. This was shown by two experiments in which a block of wood and a similar sized and shaped vessel of air were plunged in turn beneath water, and the displacement of water by the wood and the air and vessel shown to be nearly equal. A negative example of the resistance of air was shown by the violent fall of water in a water hammer, from which most of the air had been withdrawn. Air being material, and with power of resistance, it is reasonable to look to it for support when attempting to navigate in it. There have been, hitherto, two ways of navigating the air: first, by the body lighter than air—the balloon; secondly, by the body heavier than air—the flying machine. A balloon rises in the air because it is lighter than the air it displaces. This fact is explained by the principle of the pressure of fluids, and was illustrated in water by means of experiments with a cube of wood. It was Lana, in 1670, who first proposed to apply the pressure of fluids to lifting a body in air. His scheme was to empty some copper balls of air thinking thereby to make them light enough for the air to press them up, but he forgot that this very pressure of the air would crush them flat, and the crushing of an exhausted tin canister flat by the pressure of the air around was shown.

The history of the discovery of hydrogen gas, the possibilities of heated air, the first Montgolfier, and the first varnished, fairly gas-tight balloon of Charles, were described and illustrated by means of soap bubbles, fire balloons, gas balloons, heavier and lighter than air, showing the delicacy of balance in a balloon with a "flotteur frein," or balloon brake, on a balloon crossing a miniature channel. The English aeronaut Green first used ordinary coal-gas, carburretted hydrogen, for filling balloons.

Patriotism has been the stimulus which originated and has developed ballooning: its first practical use was in war; only ten years after the invention of the balloon it was in use in the French wars, captive, for observation purposes. It was so used in the late South African War. Our national balloon equipment is the finest in the world; its most important feature is gold-beaters' skin, the material of which the balloons are made. Its lightness was shown by the rising to the ceiling of a very small gold-beater's skin balloon. One ten times as large, made of varnished cambric or silk, the ordinary materials, would not lift its own weight. The method of rapid filling from steel cylinders of compressed gas was shown, also a large cylinder, such as is actually carried by our troops in war; it would take 84 such cylinders to fill a balloon of 10,000 cubic feet. Thus the advantage of a very light balloon material, which will necessitate as small a balloon as possible, is obvious. Balloons are not easily brought down by fire. Views were then shown of the war balloons in use in South Africa, and the Bruce Electric Signalling Balloon, adopted by the British, Belgian, and Italian Governments, which flashed a message, was shown.

The free balloon was used with much success in the siege of Paris. More free balloons ascend from Paris for excursions and races than from

any other city in the world. A view of a vast gathering of balloons for a race in the Vencennies competitions in the Paris Exhibition of 1900 was shown. In one of these competitions the longest balloon journey ever recorded was made by Comte Henri de la Vaulx, from Paris to Korosticheff, in Russia, 1,925 kilometres (1,196 miles) in 35 hours 45 minutes.

The longest journey upwards (about 7 miles) and partly recorded was that of Coxwell and Glaisher, in September 5th, 1862. The German aeronauts, Herren Berson and Süring, have run Glaisher's journey very close, and have actually recorded a greater height than did Glaisher.

The parachute invented by Leonardo da Vinci, long before the balloon, for descending from heights, is now a vehicle by which we can leave a balloon safely at will. As this lecture began with the important fact of the resistance of the air, it was closed by a consideration of the parachute, the most beautiful example and most practical application of that resistance. The rate of motion of a falling body depends upon the extent of its exposed surface and its shape. A falling body, folded up and open, was shown in illustration, followed by a parachute. A parachute must be of a size adjusted to the weight it has to take down, otherwise it will turn over in descending. Parachutes, properly and improperly weighted, and followed by a shower of toy parachutes, descended from the roof of the lecture theatre.

Proceedings of the Society.

CANTOR LECTURES.

THE MINING OF NON-METALLIC MINERALS.

By Bennett H. Brough.

Lecture III.—Delivered December 7th, 1903.

Stones: — Flint—Sandstone—Limestone—Marble—Dolomite and Magnesite—Slate—Eruptive rocks — Mica — Felspar — Clays — Gypsum—Sulphur—Asbestos—Bauxite—Other earthy minerals.

Stones.

In all countries stone used as building material has long formed a most valuable mineral product. Even in prehistoric times monuments were decorated with columns and statues, and the interior was often adorned with polished rocks and softer materials, such as coloured marbles, dark serpentine and white alabaster. Much information regarding building materials has been given in the Cantor lectures delivered by Professor Ansted* and by Mr. W. Y. Dent.† Large quantities of stone have also long been necessary for road making. The substances to which this lecture is devoted are, however, used for a great variety of purposes, for instance roofing slates, lithographic limestone, millstones, abrasives, the use of limestone, gypsum, fluorspar and barytes in the chemical industries, and the increasing application of asbestos and mica in engineering practice. I may also remind you of the vast quantities of sand and gravel, of clay, fireclay and kaolin, that are used for mortar, bricks, pottery, porcelain, and glass manufacture. The economic importance of all these substances will be evident from a consideration of the quantities raised in the United Kingdom alone. In 1902 the mineral produce, according to Sir C. Le Neve Foster's report, included:—

	Quantity.	Value.
	Tons.	£
Barytes	23,608	22,414
Bauxite	9,047	2,679
Chalk	4,395,673	193,757
Chert and flint	99,344	17,413
Clay	15,304,136	1,758,884
Fluorspar	6,287	3,186
Gravel and sand	2,067,745	157,741
Gypsum	224,669	78,969
Igneous rocks	5,466,964	1,400,266
Limestone (other than chalk)	12,172,851	1,382,132
Mica	8,542	3,047
Ochre, umber, &c.	16,963	22,406
Phosphate of lime	86	109
Sandstone	5,483,130	1,798,879
Slate	517,363	1,501,789
Sulphate of strontia	32,281	32,281

These figures do not include statistics of quarries under 20 feet in depth.

In the United States the value of the entire stone production in 1901 was £12,196,000.

Flint.—In the Stone Age flint was mined for tools and weapons in the chalk in East Anglia, and mining still continues for the purpose of supplying gun-flints and ornamental stone for building. Even now the Brandon knappers make a considerable number of gun-flints for export annually. Regular workshops for the manufacture of tools from the chalk

* *Journal of the Society of Arts*, vol. 13, p. 254.
† *Ibid*, vol. 35, pp. 825, 841, 855, 870.

flints also existed in the Stone Age in the sland of Rügen, at Mons in Belgium, in Sicily, and at Seneca in Missouri. Sometimes red and yellow jasper and obsidian were employed. Hammers and wedges were usually made of diorite, gabbro, and serpentine, or of the tough minerals nephrite and jadeite. Quartzite and compact lava were sometimes used for hammers. Obsidian was largely used by the ancient Mexicans. The obsidian deposit is still known as "the mountain of knives" (*sierra de las navajas*). Obsidian was also worked in the Greek island of Melos, and it is still in use among the West Australian natives.

Sandstone.—Sandstone is the most important of building stones and is widely distributed. The finer descriptions of sandstone come under the head of freestone. The British sandstones used in building are derived from beds of Devonian, Carboniferous or Triassic age. Tintern Abbey is built of Devonian sandstone. The millstone grit supplies a useful building material as it resists the action of acid in smoky atmosphere. Sheffield parish church is a good example of its use. Fine-grained sandstones are used for carving and ornamentation, whilst coarse-grained heavy stones are used for foundations, engine-beds, docks, and sea-walls. Thin bedded sandstone is used as flagstone. Under the heading of sandstone in the British statistics are included quartzite, produced by the metamorphism of sandstone, and flint conglomerate, which are used in furnace construction; and ganister, a rock found in the lower coal measures at Sheffield, consisting chiefly of fine quartz grains, which is employed for lining Bessemer converters.

Sand, derived from the disintegration of rocks, is dug in many localities. Siliceous sand free from iron is used in the manufacture of glass, and is produced at Alum Bay, Isle of Wight, at Lynn, Norfolk, at Reigate, Surrey, and at Fontainebleau, France. Argillaceous sand is used as a moulding material in foundry practice. Sand of this kind is largely worked in Belgium, where at one of the most important deposits at Lommel 800 tons a day are pumped up and loaded mechanically on to barges. The installation is of special interest as it comprises the first electrically worked sand pump driven by an alternating current dynamo. The electric machinery is supported on rafts made of empty petroleum barrels and the delivery pipe of the centrifugal pump leading to the bins along the canal is also carried on similar rafts. From the bins the sand is loaded by an electrically driven travelling elevator with endless chain into the barges. The delivery pipe of the centrifugal pump delivers the sand on to a coarse sieve to remove foreign material before entering the bins. In 1900 the production of sand in Belgium was 653,780 cubic metres, valued at £50,199.

Limestone.—Next to sandstone, limestone is the building stone most largely used. It is derived from beds of Devonian, Carboniferous or Oolitic age. The Devonian limestones are often crystalline and are largely quarried for marble. The Oolitic limestones are largely employed for building purposes, the Bath stone from the Great Oolite being the best known. Portland stone, from the Upper Oolite, was used for the west front of St. Paul's Cathedral (1700), and for Somerset House, the National Gallery, the Royal Exchange, the Tate Art Gallery, and the Law Courts. Caen stone from quarries in Normandy has been used in England since the time of the Norman conquest. The best known examples are the Temple Church and Winchester and Canterbury Cathedrals. Kentish rag, from the lower greensand near Hythe and Folkestone, has largely replaced Portland stone as a building material in London. It is much used in rubble work and also as a road material near Maidstone. Limestones free from phosphorus are used as a flux for iron smelting. Large quantities are also used in the production of quicklime for building purposes. The so-called Bath stone is mined at Corsham in Somersetshire. The bed varies from 8 to 24 feet in thickness with a dip of 1 in 33. It is mined by driving a main heading 16 feet in width from the inclined plane from the surface, with side holes at right angles 24 feet wide, leaving pillars 10 feet square. In order to remove the stone a horizontal groove is cut in for a depth of 5 feet and a width of 25 feet. Vertical cuts are then made with a saw, and the blocks detached by wedging. According to Sir C. Le Neve Foster a workman can saw 15 square feet in an hour.

In one respect limestone is unequalled, and that is in the preparation of lithographic stones, for which the Jurassic limestone of Solenhofen, in Bavaria, is specially suitable. It is exported to all parts of the world. In 1902 the production was 9,020 tons, valued at £35,957.

In fissures in limestone transparent crystals of calc-spar are frequently found. The best variety is the doubly refracting spar from Iceland, which is largely used for polarisation apparatus. Pure lumps are worth 28s. to

£5 5s. per pound. In Kent and Essex large quantities of chalk are quarried for use in the manufacture of Portland cement.

Marble.—Although marble, that is, limestone sufficiently compact to receive a polish, is of frequent occurrence, at the present time the marbles of Upper Italy and Greece are the most valued. In Italy the Carrara district is situated between Spezzia and Leghorn on the Mediterranean seaboard. The marble strata, beds of crystalline limestone of Triassic age, cover an area of 80 square miles, and reach in places the enormous depth of three-quarters of a mile. The mines, some of which were worked by the Romans 800 B.C., are surface workings at an altitude of 700 to 3,000 feet above sea level. The railway for transporting the marble, which I described in a previous lecture,* presents several points of interest. Owing to the rapid rise of the ground it was impracticable to send a separate branch up to each mine from Carrara, following the ancient water-courses occupied by bullock cart roads; and rope traction would have necessitated placing a powerful stationary engine at each of the nine mines. It was consequently necessary, with grades of 4 to 6 per cent., to have a series of reverse stations. The construction of the railway was a work of some difficulty, as there are 15 tunnels and 16 bridges and viaducts, the remainder consisting of cuttings and sustaining walls from 16 to 46 feet in depth. In the Carrara district there are now 611 quarries in operation, 345 of which are at Carrara and 50 at Massa. The number of persons employed in the marble industry in 1901 was 10,549. The quantity of marble shipped in 1901 was 290,570 tons, valued at £465,000. Of the shipments there were sent to

	Per cent.
United States	20
Great Britain	15
France	13
Germany	8
Spain and Portugal	5
Italy	20
Other countries	19
Total	100

Ordinary kinds fetch 4s. 3d. to 7s. per cubic foot, f.o.b. Leghorn. Better qualities for statuary fetch 15s. to 30s.

The helicoidal wire saw has been employed for quarrying marble at Carrara for some years. It is an endless cord, composed of three hard wires twisted together, which is made to travel along by machinery and is fed continuously with sand and water, the sharp particles of sand gradually cutting a groove. As the groove is deepened the cord must necessarily be kept to the rock. This is effected by guiding-pulleys mounted in pits sunk at the ends of the proposed cut. These pulleys must be at least 20 inches in diameter, and the pits somewhat larger. In some quarries a rotative borer is employed for sinking these pits composed of a steel tube cutting an angular groove. The wire saw was applied at Carrara for subdividing blocks of marble, but the impracticability of using the revolving cylinder, or hand labour for sinking inclined pits, was an obstacle to its further use. The difficulty was, however, overcome by Mr. Monticolo, who invented an ingenious appliance which he termed a penetrating pulley, with which it is possible to replace the somewhat costly pit by a bore-hole 3 inches in diameter. The penetrating pulley consists of a disc 20 inches in diameter, and ¼ inch thick, with a semi-circular groove round its periphery, deep enough to take half the thickness of the wire, the other half projecting. The disc is mounted on a pivot, and is supported by a hollow steel shaft of slightly smaller diameter than the bore-hole. To the shaft is attached a series of tubes of equal diameter, forming a column that may be lengthened at will, in the interior of which is a fine tube, serving for the lubrication of the pivots. As the cut deepens the pulley is fed down automatically by means of an eccentric. For cutting a groove two bore-holes, to receive the shafts carrying the axes of the pulleys, are first made by hand or by the diamond drill. The pulley was first applied in March, 1898, at the Campanile quarry, Carrara, where cuts have been made 50 feet long and 16 feet deep, inclined at an angle of five degrees from the horizontal. The highly satisfactory results obtained with the penetrating pulley serve to show that there is a great saving of expense by the substitution of bore-holes for pits, far less waste of valuable marble, increased rapidity of quarrying, and consequently increased output. In Italy there are numerous other marble quarries worked on a smaller scale, notably those of the celebrated yellow marble of Jurassic age at Siena.

The marble wealth of Greece, famed in classic times, has been developed only during the past ten years. In 1894 Mr. Brindley rediscovered the original quarries of the genuine "Verde Antico," the most valuable marble of antiquity, near Larissa in Thessaly, after

* *Journal of the Society of Arts*, vol. xl. p. 825 (1892).

having lain idle since the time of the Emperor Justinian in the 6th century, and a company was formed in 1896 (the Verde Antico Mining Co., capital £20,000), to work these famous quarries. It is believed that the columns of St. Sophia, Constantinople, and the decorations in St. Mark's, Venice, were obtained from these quarries. An English company formed in 1897 (Marmor, Ltd.), owns the Pentelikon quarries near Athens, from which the columns of the Parthenon were extracted. Perhaps the largest ancient quarries are those of Styra in Eubœa. The marble, which is much esteemed at present, can be obtained in almost any lengths. It has been used for the Belfast Town Hall. The quarries of the island of Paros, which supplied the Parian marble from which the Venus of Milo in the Louvre was carved, have not yet been satisfactorily re-opened. Nearly all the known marble quarries in Greece are owned by Marmor, Ltd., a company formed in 1897 with a capital of £350,000. Its output has increased from 2,244 tons in 1897 to 15,920 tons in 1902. The mechanical equipment of the quarries is excellent, especially at Pentelikon, where there is a large steam saw mill. The marble which is worked by the wire saw is transported down self-acting inclines, a seven-mile railway connecting with the main line. The Verde Antico Marble Company, Ltd., founded in 1896 with a capital of £20,000, also works its quarries in Thessaly with the wire saw, and exported 500 tons in 1902. The total production of Greek marble in 1902 was 17,220 tons. A map showing the various marble areas in Greece has been prepared by Mr. Percy Bennett, of the British Legation at Athens. Belgium is also an important source of marble. The centre of the industry is in Namur, the beds being of Devonian and Carboniferous age. In Austria, the Tyrolean marble has long been esteemed for statuary purposes, the size of the block, the purity and uniformity of grain being remarkable. From a quarry in this district a magnificent white block was raised in 1902 for the Von Moltke monument in Berlin. It measured 1120 cubic feet and weighed 85½ tons. In France and Spain there are some important marble deposits in the Pyrenees and in the Sierra Morena. Coloured marbles are produced at a low price in Norway. A bed of various colours, 1,000 yards thick, occurs at Dunderland, where an important iron ore industry is being started. The marbles of Great Britain are mainly of Devonian and Carboniferous age. "Many mines of coarse and fine marble," wrote Holinshed in 1577, "are there in England; but chiefly one in Staffordshire. Of white marble also we have store. The black marble spotted with green is none of the vilest sort." The collection of Irish building materials exhibited at the Imperial Institute in May, 1903, showed that Ireland possesses a great variety of marbles of great beauty of colour. In the United States the marbles of Vermont are largely quarried, whilst in Mexico the celebrated onyx marble is the basis of an important industry. The value of the marble production of the principal countries in 1901 may be summarised as follows :—

	£
Italy	1,000,000
United States	650,000
France	198,480
Belgium	107,000
Mexico	21,750
Other countries	1,800,000

The great examples of the decorative use of marble are St. Mark's at Venice and St. Sophia at Constantinople, and in both the finest specimens are known to have been plundered from the older buildings. The remarkable variety in the marbles used for decorative purposes can be seen in a striking manner in the new Westminster Cathedral. Sixty specimens of marble from different parts of the world were procured, after great research, by the architect, Mr. W. Brindley. In the crypt the columns are of red Norwegian granite, with capitals of Hopton Wood marble and Derbyshire marble bases. The 29 columns on either hand of the nave, with capitals of Carrara marble, are of *verde antico*, of Greek *cippolino* (white marble with green veins) from Eubœa, Swiss *cippolino* from Saillon in the Rhone Valley, Italian breccia from Serevazza, grey granite from Norway, and red granite. These shafts, 13 feet long, each stand on a base of Norwegian granite.

Dolomite and Magnesite. — Magnesian limestone or dolomite is largely used in the manufacture of Epsom salts, and, when calcined, as a lining for basic steel furnaces. The massive and granular varieties are quarried as building stones in Yorkshire, Derbyshire, and Nottinghamshire. This stone from quarries at Bolsover, Derbyshire, and at North Aston was used for the Houses of Parliament. For lining steel furnaces dolomite has to be dead-roasted until all the carbonic acid and water are removed. For this purpose magnesite, native magnesium carbonate, is frequently used, and would be exclusively used if the

supply was not limited and the price correspondingly high. It occurs in thick beds in Styria, in Eubœa, in Hungary, at Frankenstein in Silesia, at Krubschitz in Moravia, at Snarum in Norway, and in California and Texas. The purest variety occurs in the Salem district in Southern India. From unpublished information kindly furnished by Mr. H. G. Turner, a member of this Society, owner of the mines, we learn that the deposits (Fig. 9) are situated two miles from Salem, 200 miles from the port of Madras, and an equal distance from the port of Beypore on the west coast. The depth of the deposit is unknown. The mineral contains 47·35 per cent. of magnesia, 51·44 per cent. of carbonic acid, 0·30 per cent. of ferric oxide and alumina, and 0·27 per cent. of moisture, 0·22 per cent. of insoluble siliceous matter and no lime. Its specific gravity is 3·056. It is quarried and ground in mills of primitive construction (Fig. 10). Numerous experiments have been made to discover a simple process for making a plaster cement from this substance. It affords, when properly treated, a permanently hard white or coloured plaster which takes a brilliant polish; it is also suitable for tiles, artificial stones, and covering for floors, terraces, walls, and roofs. It is impervious to damp and is a protection against heat, advantages of extreme importance in its use in tropical countries. In the preparation of the magnesite for the manufacture of fire-bricks, and for linings and hearths for steel furnaces, excellent results have been obtained. Magnesite bricks now on the market are deficient in refractory qualities because the minerals in which they are made contain too great a proportion of other ingredients. Thus the Hungarian magnesite contains 3·2 per cent. of ferrous oxide, and the Grecian magnesite contains 4·02 per cent. of carbonate of lime. Nor are these magnesites properly dead-burnt or shrunk before being made into bricks, so that these bricks contract and lose shape when subjected to great heat, as in metallurgical processes, where bricks of stable quality are indispensable to prevent constant renewals and repairs. In order to produce a good magnesite brick, that is, a brick consisting essentially of pure magnesium oxide, it is necessary, not only to dead-burn the crude material, but to subject it to such an intense heat as to cause it to crystallise. Mere calcining in a cupola, or even in a Siemens' furnace, cannot effect this physical change in the condition of the substance. The only heat which can do this is that of the electric furnace, and Indian magnesite is pure enough to undergo the ordeal. Recent experiments made on a considerable scale show that under the intense heat of this furnace, the Indian mineral crystallises into a hard, dense mass, yielding a product of the greatest refra tory quality,

Fig. 9.

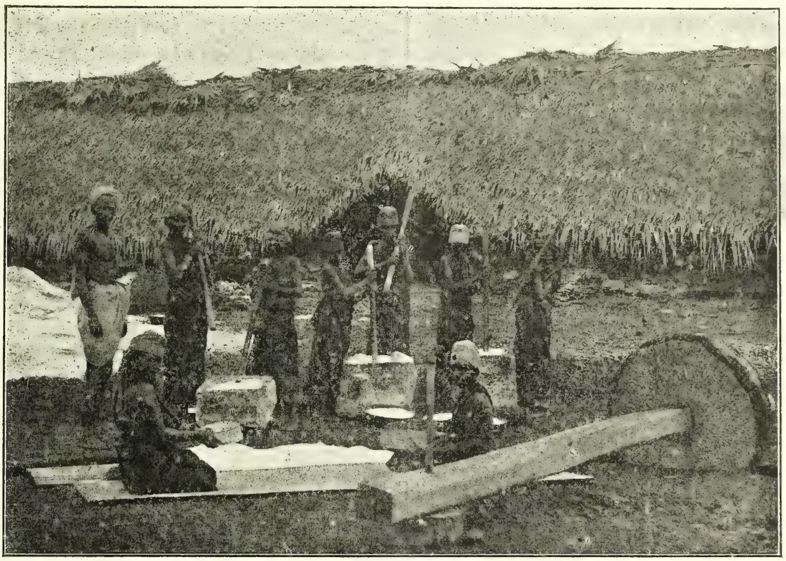
Magnesite Deposit, Salem.

which is not only adapted to the manufacture of bricks, but, when powdered and mixed with some adhesive material, it affords a paste and a mortar sufficient to protect the brick walls of furnaces from attack. For instance, it has been found that when the fire-bricks lining a melting pot in a calcium-carbide furnace were fixed with mortar and covered with a wash of this crystallised and ground magnesia they lasted for 200 hours without repair, whereas the unprotected bricks required repair after a five hours' heat. This crystallised mass itself, without further preparation than being crushed to suitable dimensions, will, it is thought, prove of special value as a refractory material in metallurgical practice. An important point in connection with its use as linings for electric furnaces is that magnesite, unlike lime, does not form a carbide with carbon.

The deposits of magnesite in the Island of Eubœa are among the largest and richest known. Quarries are worked by the Anglo-Greek Magnesite Company, Ltd., the output in 1901 being 13,000 tons of raw and 2,100 tons of calcined magnesite. The company has ten kilns in operation, and can turn out about 70 tons of calcined magnesite a day. At the Greek magnesite mines until recently, roughly built kilns fired by wood were employed for calcining the ore, which required a large quantity of fuel. In recent years, however, modern shaft calciners have been built, and a soft lignite coal is used. Magnesite is used in the crude state for manufacturing carbonic acid, for whitening paper pulp, and for whitening wool. Its selling price f.o.b. Greece is about 14s. per ton raw, and £2 10s. calcined. In 1900 Greece produced 17,277 tons valued at £13,822, and the United States in 1901 produced 11,953 tons valued at £8,611.

In association with magnesite in Asia Minor the hydrated magnesium silicate, meerschaum, occurs in soft nodules and reniform masses. Large quantities are sent to Vienna and Paris to be carved into pipes.

Fig. 10.



Grinding Magnesite, Salem.

Slate.—Among the sedimentary rocks, slate is of the greatest value. It is used for roofing purposes, as well as in large slabs for billiard-tables, cisterns, steps, &c., and for minor purposes such as school slates and pencils. The best slate is obtained from North Wales, where it has been worked since the 16th century. Three-fifths of the Welsh slate is produced from open quarries, and two-fifths from underground workings. The largest open quarries are at Penrhyn, near Bangor, and at Dinorwic, near Carnarvon, whilst the largest underground workings are those belonging to the Oakeley Slate Quarries Company, Ltd., at

Festiniog. The principal bed is 120 feet thick, and this thickness has necessitated the excavation of vast chambers, some of which are 100 feet high and 50 feet wide. Some remarkable photographs of these chambers at the Oakeley and Llechwedd mines have been made by Mr. J. C. Burrow, and will be remembered by visitors to the exhibitions of the Photographic Society. The method of working the slate is roughly as follows :—A main incline tunnel is driven from the top of the bed, and from this tunnel cross tunnels, termed floors, are driven right and left. Each of the floors is divided up into pillars and chambers, the average depth of each chamber being 50 feet. At Rhiwback, Mr. H. Humphris has introduced an ascending method of working in which all the rock available is procured at low cost. Small cross levels, 4 feet wide and 8 feet high, are driven at right angles to the main level. As soon as two of them are 25 to 30 yards long, the rock between is undercut by the wire saw, and top cut at a height of 6 feet above. The block is sliced off and rough dressed underground. The waste produced is stacked up to the level of the roof so as to form the floor of the next gallery. At Labassère, in the Pyrenees, the wire saw is employed to make horizontal cuts across the inclined beds of slate, severing great blocks without blasting. Believing that a similar system could be employed with advantage in North Wales, Sir C. Le Neve Foster recommended that Mr. G. J. Williams, Assistant Inspector of Mines, should study the question on the spot. The Home Secretary having acceded to this suggestion, Mr. Williams drew up a very valuable report, which was published in 1900. The investigation clearly showed that slate might be worked in many quarries in North Wales by the wire saw method with great advantage. There would be less blasting, fewer falls of ground, less waste of good rock, reduced cost of working, less cost of explosives, a saving in the cost of unproductive work, a saving in the cost of removing rubbish, no need for quarrying worthless rock in underground workings, and the cost of examining and securing the roofs and pillars would be done away with. In Cornwall the Delabole quarries have long been celebrated for the production of slate of good quality.

In Ireland there are some good slate deposits that have only been holed to supply slates for local use. Some of these appear as if they might be profitably opened up, although Irish slates, as a rule, are heavier and not of as good a colour as the Welsh.

On the Continent slate is quarried at St. Goar, Rüdesheim, Oberwesel, and Andernach on the Rhine, in the Hartz, at Erfurt in Saxony, in Austria near Teschen, while in France, the Angers slate quarries are the most celebrated. There some 3,000 workmen are employed, and some of the workings are more than 900 feet deep. Devonian rocks are largely quarried for slates in the French Ardennes at Deville, Fumay, and Rimogne. The production of slate and slate slabs in France in 1901 was 289,812 tons, valued at £694,800.

Eruptive Rocks.—Eruptive rocks are extensively used for road metal. Granites, syenites, and diabases appear to be the best for the purposes. Granite has been used for constructive purposes from the earliest times. From the quarries of ancient Egypt were hewn the monolithic obelisks, which have been carried from their ancient sites to adorn London, Paris, and Rome. The British granite districts are in Devon, Cornwall, the Channel Islands, Lundy Island, Mount Sorrel in Leicestershire, and Shap Fell in Westmoreland. The granite of Devon and Cornwall has been largely used in London, notably for Westminster, Waterloo, and London bridges. The Duke of Wellington's sarcophagus in St. Paul's Cathedral is made of red granite from Luxulion, in Cornwall. The Mount Sorrel granite is pre-eminently suited for road metal. The Scotch granites are better, in that the quartz is more uniformly distributed. The granite districts of Scotland are in Aberdeen, Peterhead, and the Island of Mull, in Argyllshire. The Peterhead rich pink granite is largely used for ornamental purposes as in the pillars of the Carlton Club. The granite districts of Ireland are in Wicklow, Galway, Mayo, Donegal, and Down. The largest quarries are those near Dalkey. The polishing of granite has been fully described by Mr. G. W. Muir.* In former times basalt was largely used as road metal. The columnar structure of this rock, so picturesquely shown at Fingal's Cave, and at the Giant's Causeway, facilitated to a certain extent the comminution of the material. The use of basalt as road metal has, however, decreased owing to its becoming slippery with wear. Like basalt, the greenstones and whinstones are ill-adapted for building purposes, owing to their great hardness and sombre colour. Their principal uses

* *Journal of the Society of Arts*, vol. 14, p. 471.

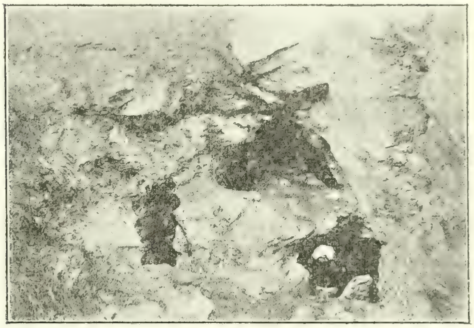
are for paving and road metalling. The most important quarries are at Bardon Hill, Leicestershire, and Penmaenmawr, North Wales.

Of the rocks that are chiefly used for interior decoration and for the manufacture of decorative objects, serpentine, owing to the variety and beauty of its colours, is the most important. It is usually of a dark green or red colour. It is believed to be an alteration product of other rocks, and in composition is a hydrous magnesium silicate. It is largely worked in the Lizard district of Cornwall, at Zöblitz in Saxony, and at Espinal in the Vosges. At Zöblitz the bed extends for two miles with a thickness of twenty yards, in gneiss, and has been quarried since the 15th century.

Mica.—As one of the constituents of granite and other rocks, mica is widely distributed, and it has many industrial uses. The earliest use of mica was probably, under the name of Muscovy glass, for window panes. It is now chiefly used as a transparent medium unaffected by a sudden exposure to heat, in the doors of stoves, in the peepholes of furnaces, and as lamp chimneys. The largest quantity is used for electrical purposes for covering portions of dynamos, and in India for decorative purposes. The waste scrap is turned to account as a lubricant, as electric insulator, as non-conducting packing, and in paper manufacture. Large crystals form a valuable product. Clear crystals measuring 8 inches square fetch 18s. per lb., and scrap mica 13s. per cwt. A single crystal from North Carolina has been known to weigh nearly a ton. The world's supply is obtained from India, the United States (North Carolina and New Hampshire), Canada (Quebec), and Brazil. Small quantities are also raised in Norway, Siberia, and China.

In India, mica mining is an industry of considerable importance. In 1900 there were 131 mines, employing 9,517 persons, at work on mica. The total output amounted to 916 tons, more than half of which was raised in the Nellore district, Madras, which is now outstriping Bengal in the development of its mica resources. The Indian mica deposits have been well described by Mr. T. H. Holland, of the Geological Survey of India. He shows that the mineral, Muscovite mica, occurs as a constituent of granite pegmatite. Crystals have been obtained in the Nellore district measuring 10 feet across the basal planes, but usually they are much smaller. In the Imperial Institute collection there is a crystal 3 feet by 2½ feet, weighing 64 lbs. The pegmatites worked for mica have been intruded into the schists in the form of sheets following the foliation, or less often as dykes cutting the schist obliquely. The system of mica mining carried on, largely under European management, is of the most wasteful and primitive type possible. In the Bengal area the mines are narrow irregular holes following the mica from crystal to crystal sometimes to depths over 200 feet. All the materials are brought to the mouth of the hole, often near the top of a hill where the pegmatite outcrop was originally discovered. (Fig. 11.) Mining has to be suspended in the rainy season, and an hour is spent every morning in baling out the water accumulated overnight. In Nellore the mineral is raised in

FIG. 11.



ENTRANCE TO MICA MINE, HAZARIBAGH DISTRICT. (Photographed by T. H. Holland).

open quarries, the slope of whose sides is determined by the angle of repose of the surrounding schists. That mica mining has yielded large profits in these circumstances indicates the value of the deposits, and suggests that with a more rational system of mining of the abundant mineral still available, India should continue to hold its place as the leading mica-producing country. The mica sheets are trimmed by cutting off the broken and flawed edges, and are sent to the London market in sheets of irregular shape. An important part of the dressing operations consists in splitting the mica to remove in inclusions of foreign minerals that would, if allowed to remain, lessen the value of the sheet. Cutting into rectangular sheets is but little practised owing to the lower duty on unmanufactured mica imported into the United States.

In the United States mica is obtained

in North Carolina from veins of giant granite, 30 feet wide, in mica schist. Mica also occurs in workable quantities in Brazil. The deposits, which have been described by Mr. H. Kilburn Scott, are pegmatite veins, lenticular masses or dykes, occurring in metamorphic schists. In Cornwall mica is obtained as a by-product in the preparation of China clay, the amount yielded in 1901 being 3,216 tons valued at £1,266. During that year the Indian production was 1,159 tons, valued at 995,192 rupees. The United States produced 360,060 lbs. of sheet mica, valued at £19,752, and 2,171 tons of scrap mica, valued at £3,944. The value of the Canadian output was £32,827.

Felspar.—Another constituent of granite and other rocks, of great economic importance is felspar. Orthoclase or potash felspar, is largely used for the manufacture of porcelain. It is quarried at Trenton, New Jersey, and at East Liverpool, Ohio, and considerable quantities are raised in Norway and Bohemia. The prices varies from 10s. to £1 per ton. In 1901 the United States produced 31,525 metric tons of felspar, valued at £44,084; Norway, 17,609 tons, valued at £6,400; Sweden, 15,228 tons, valued at 10,330; and Canada, 4,741 tons, valued at £968.

Clays.—From the decomposition of the soda-felspar in granite, kaolin or china clay is obtained. It is the purest variety of clay, and is largely worked for the pottery at St. Austell, in Cornwall. The kaolin is separated when the soft, altered granite is washed down by a current of water. The rise and progress of the industry was dealt with in great detail in a paper read before the Society by Mr. J. H. Collins* in 1876. The amount shipped from Cornwall in 1902 was 562,502 tons.

FIG. 12.

DIGGING CLAY, RAEVELS, BELGIUM.

For the manufacture of bricks clay is worked in large quantities in the United Kingdom. Fire-clay is largely mined in the coal measures, forming the under-clay of some of the seams. Devonshire and Dorsetshire yield pottery clays of Lower Tertiary age. Bedfordshire and Surrey yield fuller's earth from the Lower Greensand, and Somersetshire yields it from beds of Jurassic age. In the United States the plastic clays of New Jersey, and most of the brick, tile, and terra cotta clays of Delaware, Maryland, and Virginia, are of Cretaceous age. The United States output

* *Journal of the Society of Arts*, vol. 24, p. 565.

of clay products (bricks, tiles, and pottery) in 1901, is valued at £22,000,000. The output of clay was 1,367,170 tons, valued at £515,000. On the continent clays are extensively worked. In the north of Belgium there is, in a series of alternating beds of blue or grey compact clay and sands, a bed 3 to 20 feet thick of clay of remarkable plasticity, the composition of which renders it specially suitable for the manufacture of artificial Portland cement. It is used for that purpose by six of the ten cement works in Belgium. The clay worked at Raevels (Fig. 12) has, when dry, the following composition :—

Silica	65·25
Alumina	21·10
Ferric Oxide	5·20
Lime	1·20
Magnesia	0·50
Alkalies	0·10
Loss on ignition	7·65

Gypsum.—Gypsum consists of calcium sulphate with 21 per cent. of water. It forms great masses in stratified rocks. In England, it is mined in Nottinghamshire, Staffordshire, and Cumberland, from beds of Triassic age, and in Sussex, from a seam belonging to the Purbeck beds. More than half the world's supply is produced in France, where gypsum of Tertiary age from the Montmartre quarries, Paris, is used as building material. The world's production in 1901, was as follows :—

	Metric tons.
France	1,991,000
United States	598,602
Canada	266,531
United Kingdom	203,988
Switzerland	45,987
Germany	39,000
Cyprus	5,373
India	4,415
Italy (alabaster)	2,714
Mexico	1,600
Algeria	600
Greece	82
	3,159,892

In its transparent crystalline state gypsum is known as selenite. When it presents a finely fibrous appearance it is termed satin-spar, and is used for beads, the best quality being worth about £7 a ton. When resembling white marble it is known as alabaster, and is worked mostly in the Volterrano district in Tuscany into vases, statuettes, and other artistic objects. When calcium sulphate is not combined with water it is anhydrite, a rock likely to absorb water and pass into gypsum. Ordinary gypsum is chiefly used for the manufacture of plaster of paris and cements, and as a fertiliser. Some 350,000 lbs. are, according to Mr. A. T. Metcalfe, annually used for the Burtonising of beer. The mode of formation of gypsum deposits is thought to have been as follows : In salt lakes, water is evaporated, and as it becomes concentrated, salt and gypsum are precipitated, forming solid masses at the bottom ; gypsum being less soluble than salt, is precipitated first. The process can be observed at the Dead Sea and at the Great Salt Lake.

Sulphur.—By the reducing action of organic matter on sulphate of lime (gypsum) sulphur is formed. This explains the origin of the celebrated sulphur deposits of Sicily which occur in Miocene limestone, with the unaltered beds of gypsum below. Other deposits of sulphur in Japan, Mexico, Utah, California, Nevada, and Alaska are products of volcanic activity, as also are the Iceland deposits described by Mr. Vincent.* The deposition of sulphur may be seen in progress at La Souffrière in St. Lucia, West Indies. In Louisiana there are deposits resembling those of Sicily. The world's production of sulphur in 1900 was as follows :—

	Metric tons.	Per cent. total.
Italy	544,119	94·0
Japan	14,435	2·5
France	11,551	2·0
United States	3,199	0·5
Germany	1,420	0·2
Greece	891	0·1
Austria	862	0·1
Spain	750	0·1
Russia	451	—
Hungary	123	—
Sweden	70	—
World's total	577,420	100·0

The value of the world's production is estimated at £2,139,696. Sulphur has been used as a disinfectant since the earliest times. In the Odyssey (Book xxii.) after Ulysses had slain the suitors :

> " To Euryclea then address'd the king :
> ' Bring hither fire, and hither sulphur bring
> To purge the palace.' "

In the manufacture of sulphuric acid sulphur is now largely replaced by iron pyrites. The chief use of sulphur is now for dressing vines, and in the manufacture of paper by the

* *Journal of the Society of Arts*, vol. 21, p. 137.

sulphite process in which wood pulp is digested under pressure with sulphurous acid. In Sicily the sulphur mines are distributed over a wide area near Girgenti in the south of the island, the sulphur occurring in a bed of Upper Miocene limestone in places as much as 164 feet thick. The methods of mining are of a primitive description, the crude rock being carried to the surface in sacks, up winding staircases by boys. The shipments of sulphur from Sicily, amounted in 1902 to 467,319 tons. There were 734 mines in operation, and 32,604 miners were employed. For the extraction of sulphur the old process of liquation in kilns has now been largely superseded by improved methods in furnaces and steam apparatus. Last year the kilns yielded only 38·01 per cent. of the total output. The world's stock of sulphur is now practically held by the Anglo-Sicilian Sulphur Company, Ltd. (paid-up capital, £735,000), which made for the year ending July 31, 1903, gross profits of £154,649. In the United States the production of sulphur in 1902 was 8,336 tons, valued at £44,112. The imports during that year represented a value of £656,127, Sicily supplying 163,571 tons valued at £622,394.

Asbestos.—In commerce, under the name of asbestos, two distinct minerals are known, namely amianthus, an anhydrous silicate, a brittle fibrous hornblende that is not acted upon by acids, and chrysolite or serpentine asbestos, a hydrated compound that is acted upon by acids, but is characterised by the great elasticity of its fibres. The properties of these minerals have been fully described by Mr. J. Boyd* and by Mr. Robert H. Jones.† The first of these minerals occurs principally in Italy and Austria, while the latter is produced mainly in the province of Quebec, Canada. Both minerals may be easily divided into fine fibres which can be spun like cotton. The waste material is compressed, or when powdered it forms the basis of fire-resisting paint. Among the economic minerals of Canada, asbestos takes the first rank. Whilst in 1880 the production was only 380 tons, in 1901 it was 38,500 tons, representing a value of £300,000. In that year the world's production included :—

	Tons.
Canada	34,545
Russia	3,845
United States	678
Italy	300
Tasmania	90
Cape Colony	89

* *Journal of the Society of Arts*, vol. 34, p. 582.

† *Ibid*, vol. 45, p. 543.

In Canada asbestos is mostly obtained in quarries. The better sorts are picked out by hand. The first sort has fibres of over $1\frac{1}{4}$ inches in length, whilst the second is $\frac{1}{4}$ to $1\frac{1}{4}$ inches. The poorer qualities known as "fibre" and "paper stock" are produced by mechanical dressing. The Danville Co. pulverises the waste, and with a certain addition of serpentine obtains asbestic, a product now largely used for fire-proof buildings. According to Mr. F. Cirkel, 100 tons of mineral raised yield $1\frac{1}{2}$ tons of crude and 5 to 8 tons of fibre and paper stock. The price is :—

	Per ton (dols.).
First sort crude	180–200
Second sort crude	100–128
Fibre	30–60
Paper stock	20–28
Asbestic	2–4

The production of the different qualities in 1901 was :—

First crude	2,083 tons.
Second crude	2,660 ,,
Fibre	14,659 ,,
Paper stock	14,054 ,,
Asbestic	6,831 ,,

In the Thetford Black Lake district there are at work twelve great companies with a capital of over four million dollars. The industry affords employment to 3,000 workmen, who earn 4s. 7d. to 5s. for a ten-hour shift. The largest company is Bell's Asbestos Co., Ltd., with a paid-up capital of £120,000. This company employs 400 workmen at its mines at Thetford, and is equipped with machinery of the latest type ; it also has a first-class plant for the mechanical separation of asbestos. Johnson's Co., Ltd., incorporated in Quebec, in 1885 (capital 250,000 dols.) is the oldest company at Thetford, and produces asbestos of specially good quality.

Bauxite.—The hydrate of aluminium, identified by Berthier, in 1821, at Baux, near Arles, and named in consequence bauxite, is now largely worked for the manufacture of aluminium, and as a fire-resisting material. In Ireland it occurs with beds of iron ore between sheets of tertiary basalt in County Antrim. The bulk of the world's supply is, however, obtained from the United States and France. At Baux it occurs in masses in the chalk. The world's production, in 1901, was as follows :—

	Metric Tons.
France	76,620
United States	19,205
Ireland	10,355
World's total	106,180

In the United States, Georgia yields the bulk, the remainder being obtained from Alabama and Arkansas. The Arkansas bauxite occurs in the Fourche Mountain district and in Bryant township. At Bryant, it rests on kaolinised syenite, and has a thickness of about fifteen feet. Some of it is pisolitic, while the whole is of this character in the Fourche Mountain district. The deposits appear to have been due to the action of heated alkaline water on the syenite, and to subsequent superficial chemical reactions on the deposits left by the springs.

Other Earthy Minerals.—There are numerous other useful earthy minerals, some of which may be briefly mentioned. Minerals used as abrasives, oilstones and whetstones, grindstones and buhrstones, are in increasing demand from year to year. Some of these, crystalline quartz, garnet, corundum, and emery, will be incidently noticed under the head of precious stones. In the United States, the total value of all the natural abrasives produced in 1901 was £297,000. Infusorial earth, or kieselguhr, is largely used as a polishing powder as well as an absorbent for nitro-glycerine in the manufacture of dynamite. It is also used as a non-conductor of heat for coating steam-pipe. It is a siliceous earth, consisting entirely of the microscopic shells of diatoms. It is found in the Lüneberg Moor in Hanover, in the Siegen district, in Scotland, and in Italy. In the United States, the most important deposit is at Red Mountain in Nevada. Pumice is also used for polishing. It is a glassy lava, rendered porous by the escape of gas through its mass when in the state of fusion. The most important source of supply is the Lipari Islands, which exported 6,834 tons in 1901. The deposit covers about 3,706 acres. Monte Pelato, the centre of the industry, is an extinct crater, on which the accumulations of pumice reach in places a thickness of 650 feet. All material is now got from extremely primitive underground workings in a bed 3 to 12 feet thick. About 1,200 persons are engaged in the industry. In 1901 the production was 8,300 tons, valued at £31,000. In the mineral paint industry, there are several raw materials that may here be mentioned. The ochres, which consist chiefly of ferric hydrate, are largely used, while the clayey ferric oxide, bole, gives the well-known bright red colour. The world's production of ochre in 1901 included:—

	Tons.
France	36,454
United States	16,711
United Kingdom	16,287
Germany	12,681
Canada	2,233
Cyprus	1,098
Belgium	330
Spain	64

The pumice sands and tuffs of the Eifel, known as trass, are used for making mortar, as is also puzzuolana, the volcanic ash that is quarried at the foot of Vesuvius. In the small group of useful minerals, not ores, occurring in mineral veins, barytes, fluorspar and strontianite are of considerable value.

In the United Kingdom, barytes or heavy-spar is obtained from veins in Silurian rocks, or in the carboniferous limestone in three principal districts—Northumberland, Shropshire, and Ireland. The first supplies witherite, the carbonate; and the second and third, mainly heavy-spar, the sulphate. In the United States, this mineral is widely distributed. It is used chiefly for adulterating white lead paint. The world's production in 1901, included, in metric tons:—United States, 44,516; Germany, 88,000; United Kingdom, 28,054; Belgium, 22,800; Canada, 592. Fluorspar is mined in Derbyshire under the name of "Blue John." It is used as a flux in smelting operations, in the manufacture of hydrofluoric acid for etching glass, as a glaze for pottery, and in the manufacture of opalescent glass. By far the largest amount is used in fluxing iron. In 1901, the world's producduction comprised, in metric tons:—United States, 17,768; Germany, 29,000; United Kingdom, 4,232; France, 3,970. Sulphate of strontium is dug from shallow pits in Gloucestershire and Somersetshire. It is found in the red marl belonging to the Keuper beds. The chief supply is obtained from Hamm, in Westphalia, where seventeen mines, in 1901, produced 1,020 tons, valued at £73,875. There is small demand for the mineral. It is used by firework makers and in the treatment of beet sugar.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock:—

JANUARY 20.—"Organ Design." By THOMAS CASSON.

JANUARY 27.—"Ice Breakers and their Services." By ARTHUR GULSTON.

FEBRUARY 3.—"Steam Cars for Public Service." By THOMAS CLARKSON, M.I.Mech.E. LIEUT.-COL. H. C. L. HOLDEN, R.A., F.R.S., will preside.

FEBRUARY 10.—"Thermit." By CHARLES VERNON BOYS, F.R.S.

FEBRUARY 24.—"Mahogany and other Fancy Woods available for Constructive and Decorative Purposes." By FRANK TIFFANY.

INDIAN SECTION.

Thursday Afternoons, at 4.30 o'clock :—

JANUARY 14.—"The Presidency of Bombay." By SIR WILLIAM LEE-WARNER, K.C.S.I., Member of Council. The RIGHT HON. ST. JOHN BRODRICK, M.P., Secretary of State for India, will preside.

FEBRUARY 11.—"Our Commercial Relations with Afghanistan." By COLONEL SIR THOMAS HUNGERFORD HOLDICH, R.E., K.C.M.G., K.C.I.E., C.B., Member of Council. The Right Hon. SIR J. WEST RIDGEWAY, G.C.M.G., K.C.B., K.C.I.E., will preside.

COLONIAL SECTION.

Tuesday afternoons, at 4.30 o'clock :—

FEBRUARY 2.—The Biology of Federation." By the Hon. SIR JOHN ALEXANDER COCKBURN, K.C.M.G.

APPLIED ART SECTION.

Tuesdays, at 4.30 or 8 o'clock :—

JANUARY 19, 8 p.m.—"Celtic Ornament." By GEORGE COFFEY. LEWIS FOREMAN DAY, Vice-President of the Society, will preside.

CANTOR LECTURES.

Monday evenings, at 8 o'clock :—

J. LEWKOWITSCH, PhD., M.A., F.I.C., "Oils and Fats—their Uses and Applications." Four Lectures.

LECTURE I.—JANUARY 25.—Extent of the Oil and Fat Industries—Sources of Supply—Raw Materials—Modern Methods of Manufacture.

LECTURE II.—FEBRUARY 1.—Methods of Refining — Bleaching — Demargarinating Processes—The Industry of Edible Oils and Fats—Butter Substitutes —Lard Substitutes—Chocolate Fats.

LECTURE III.—FEBRUARY 8.—Burning Oils—Paint Oils—Lubricating Oils—Blown Oils—Boiled Oils—Varnish Industry—Linoleum Industry—Vulcanised Oils—Turkey red Oils—Modern Theory of Hydrolysis of Fats.

LECTURE IV.—FEBRUARY 15.—Modern Processes of Saponification—Candle Industry—Soap Industry —Manufacture of Glycerine—Recovery of Glycerine from Soap Lyes.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, JAN. 11...Surveyors, 12, Great George-street, S.W., 8 p.m. Discussion on Mr. H. T. Scoble's paper, "Industrial Decentralisation, an Important Factor in the Solution of the Housing Problem."

Geographical, University of London, Burlington-gardens, W., 8½ p.m.

Medical, 11, Chandos-street, W., 8½ p.m.

Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p.m. Rev. Arthur Elwin, "Ancestral Worship."

London Institution, Finsbury-circus, E.C., 5 p.m. Mr. H. F. Gadow, "Mexico and its Natural History."

TUESDAY, JAN. 12...Asiatic, 22, Albemarle-street, W., 5 p m.

Royal Institution, Albemarle-street, W., 5 p.m. Prof. L. C. Miall, "The Development and Transformation of Animals." (Lecture I.)

Medical and Chirurgical, 20, Hanover-square, W., 8½ p.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Mr. Alexander Millar, "The Electrical Re-Construction of the South London Tramways on the Conduit System."

Anthropological, 3, Hanover-square, W., 8½ p.m.

Colonial, Whitehall Rooms, Whitehall-place, S.W., 8 p.m. Mr. C. C. Lance, "Australia as a Food-Producing Country."

WEDNESDAY, JAN. 13...SOCIETY OF ARTS, John-street, Adelphi, W.C., 5 p.m. (Juvenile Lecture.) Mr. Eric Stuart Bruce, "The Navigation of the Air." (Lecture II.)

Biblical Archæology, 37, Great Russell-street, W.C., 4½ p.m. Annual Meeting.

Japan Society, 20, Hanover-square, W., 8½ p.m. Mr. Chokuro Kadono, "The Bringing-up of Japanese Girls."

Royal Literary Fund, 7, Adelphi-terrace, W.C., 3 p.m.

THURSDAY, JAN. 14...SOCIETY OF ARTS, John-street, Adelphi, W.C., 4½ p.m. (Indian Section.) Sir William Lee-Warner, "The Presidency of Bombay."

Antiquaries, Burlington-house, W., 8½ p.m.

United Service Institution, Whitehall, S.W., 3 p.m. Admiral Sir J. C. Dalrymple Hay, "The Necessity of Training Boys for the Sea Service."

London Institution, Finsbury-circus, E.C., 6 p.m. Dr. R. Hutchinson, "The Food of the People."

Royal Institution, Albemarle-street, W., 5 p.m. Mr. G. R. M. Murray, "The Flora of the Ocean." (Lecture I.)

Electrical Engineers, 25, Great George-street, S.W., 8 p.m. 1. Discussion on Mr. P. V. McMahon's paper, "The City and South London Railway: working results of the Three-Wire System applied to Traction, &c." 2. Dr. Hans Behn-Eschenburg "The magnetic dispersion in Induction Motors, and its influence on the design of these machines."

Historical, Clifford's Inn Hall, Fleet-street, E.C., 5 p.m.

Mathematical, 22, Albemarle-street, W., 5½ p.m.

FRIDAY, JAN. 15...Royal Institution, Albemarle-street, W., 9 p.m., Lord Rayleigh, "Shadows."

Quekett Microscopical Club, 20, Hanover-square, W.C., 8 p.m.

Mechanical Engineers, Storey's-gate, Westminster, S.W., 8 p.m. Sixth Report to the Alloys Research Committee on "The Tempering of Steel," by the late Sir William C. Roberts-Austen and Professor William Gowland.

SATURDAY, JAN. 16...Royal Institution, Albemarle-street, W., 3 p.m. Mr. J. A. Fuller Maitland, "British Folk Song" (with vocal illustrations). (Lecture I.)

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FRIDAY, JANUARY 15, 1904.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

NEXT WEEK.

Tuesday, January 19, 8 p.m. (Applied Art Section.) George Coffey, "Celtic Ornament."

Wednesday, January 20, 8 p.m. (Ordinary Meeting). Thomas Casson, "Organ Design."

Further details of the Society's meetings will be found at the end of this number.

SWINEY PRIZE.

The adjudicators under the will of the late Dr. Swiney are summoned to meet at the house of the Society of Arts, John-street, Adelphi, London, on Wednesday, January 20, 1904, at 4.30 p.m., to make the award in conformity with the terms of the bequest contained in the will of the testator.

(By Order)
Henry Trueman Wood,
Secretary.

EXHIBITION OF MECHANICAL ENGRAVING AND COLOUR PRINTING.

The Board of Education, in co-operation with the Council of the Society of Arts, intend during the present year to hold, in the Victoria and Albert Museum, South Kensington, an Exhibition of Engravings produced by mechanical means, such as photogravure and other photographic processes, as a sequel to the Exhibition of Engraving and Etching held during last summer; and, as great advancements have been made in printing in colours since the Exhibition of Modern Illustration in 1901, specimens of colour printing will be included. A committee, of which Sir William de W. Abney, K.C.B., F.R.S., will act as Chairman, has been formed to advise the Board in carrying out the Exhibition. All communications should be addressed to the Secretary, Exhibition of Mechanical Engraving, Board of Education, South Kensington.

INDIAN SECTION.

Thursday afternoon, January 14, 1904; the Right Hon. St. John Brodrick, M.P., Secretary of State for India, in the chair. The paper read was on "The Presidency of Bombay," by Sir William Lee-Warner, K.C.S.I.

The paper and report of the discussion will be published in a future number of the *Journal.*

JUVENILE LECTURES.

On Wednesday afternoon, January 13th, Mr. Eric Stuart Bruce, M.A, delivered the second and last lecture of his course of Juvenile Lectures of "The Navigation of the Air," which dealt with Airships, Kites, and Flying Machines.

Carlyle, in his "History of the French Revolution," typifies balloons as beautiful but "unguidable."

Attempts have been made to navigate balloons in two ways. First, by mechanical propulsion; and, secondly, by utilising the air currents. A screw has been used to cut into the air, and as long as the power of the screw is greater than that of the wind the screw-propelled balloon can make progress even against the wind; but hitherto the power taken up on a balloon has only been sufficient to overcome very moderate winds. The action of a screw was shown, and Giffard's steam navigable balloon, Tissandier's electric balloon, and Krebs' and Renard's electric balloon were explained and illustrated by lantern views and maps of their journeys. Count Zeppelin's airship was shown floating in mid-air by the aerial graphoscope, an optical instrument which shows views in the air without a screen, and was explained by a number of views. Aluminium wire was broken up to show the brittleness of aluminium and how it was that this giant airship was wrecked in the end by the wind. These various navigable balloons or airships only made return journeys against winds so light as to be practically calms. M. Santos Dumont is the

only man in the world who has made a return journey to a given spot up to time. This he did in 1891, when he gained the Deutsch prize of 100,000 francs; so that he has advanced aeronautics in practice though not in principle. His airships show originality in detail, and it is very much to his attention to detail that we may ascribe his success. He introduced the ballonet or inner balloon, and a ballonet was shown within an outer balloon, empty and inflated, and its action in preserving rigidity in the outer balloon was shown by experiment, and the power of the rigid balloon to resist pressure was illustrated by dropping weights on it which rebounded. An airship sailed round the room and made a return journey, and a vision of Santos Dumont's airship rounding the Eiffel Tower appeared in the air, followed by views of the incidents of his journeys. M. Santos Dumont has sailed against a wind of from four to five metres per second, which is a very slight breeze.

A vision of Severo's airship came next, followed by a series of experiments with hydrogen, burning soap bubbles, and red-hot platinum wire, and the electric spark in the centre of a globe of gas, showing that a safer place for motors would be in the centre of the gas of the balloon and not near the borderland just outside the balloon where hydrogen gas and air meet. The first British airship was that of Mr. Stanley Spencer which crossed London in 1902. The Lebaudy airship built throughout of steel, which was shown on the screen, has made 30 journeys, nearly all return ones; but it has hitherto only made way against very moderate winds.

In the first lecture it was stated that air currents flow in different directions. If we try to utilise them for airship travelling, we must improve the vertical up and down motion of our airships so as to save gas and ballast. Dr. Danilewsky tried to do this by his balloon, of which a picture was shown, and which may be described as between the lighter than air and the heavier than air principles, and Baron de Bradsky tried to get vertical motion in his airship by having a horizontal screw below it. The twisting action which caused the steel wires of Baron de Bradsky's balloon to break was shown by twisting a horizontal screw which twisted its supports.

Kites which rise to great heights and carry self-recording instruments are useful for this purpose, increasing our knowledge of air currents. American kites at Blue-hill Observatory have already flown over three miles high. Pictures of scientific tailless kites followed. The box kite, the form most generally used, was explained, and a modification of it which has been taken out by the Scottish Antarctic Expedition was shown, also the various kites used in the first international kite competition at Findon, arranged by the Aeronautical Society in June last.

The consideration of kites leads up to that means by which it is hoped eventually to master the air, namely, the body heavier than air—the aeroplane. If the string of a kite is cut off and the kite supplied with a motor and screw propeller as adopted by Sir Hiram Maxim and Professor Langley, in their aeroplanes, we have the flying machine. Maxim's machine was shown on its rails. Langley's original unmanned aeroplane has actually flown successfully through the air for three quarters of a mile, though the new one has flown downwards into the water instead of upwards. The difficulty of such a flying machine is to balance it. In considering the body heavier than air, we are leaving behind the balloon which, though it is the "mule" of the air, yet holds us up. The motor-driven kite or flying machine is bound to be upset by the air currents if not automatically balanced, and a number of model flying machines were seen flying about the room, exhibiting by their erratic course how the air draughts affected them. The first to experiment with gliding machines for the purpose of practising balancing in the air was Lilienthal in 1891. A gliding machine, like a parachute, depends upon the resistance of the air. The first lecture began with a study of the resistance of the air, and ended with an example of its sustaining power, and now, at the end of the course, we are brought again face to face with this important fact. A gliding machine depends upon gravity for its motive power. Lilienthal was shown gliding through the air—he made some 2,000 glides, but was eventually killed, as was Pilcher, who was also shown gliding: Pilcher was killed in trying to glide from level ground. Pictures were also shown of the successful glides of the Messrs. Wright in America. At the forthcoming St. Louis Exhibition amongst the aeronautical prizes offered is one for gliding macnines. In conclusion, simplicity in principle was urged as the basis of artificial flight; and a number of small "Penard" flying machines were given to the children.

The CHAIRMAN proposed a vote of thanks to Mr. Eric Bruce for his interesting course of lectures, which was carried unanimously.

LIST OF MEMBERS.

The new edition of the List of Members of the Society is now ready, and can be obtained by members on application to the Secretary.

COVERS FOR JOURNAL.

For the convenience of members wishing to bind their volumes of the *Journal*, cloth covers will be supplied, post free, for 1s. 6d. each, on application to the Secretary.

Proceedings of the Society.

CANTOR LECTURES.

THE MINING OF NON-METALLIC MINERALS.

By Bennett H. Brough.

Lecture IV.—Delivered December 14th, 1903.

Precious Stones.—Diamond—Corundum gems—Emerald—Other precious stones—Ornamental stones—Rare earths.

Precious Stones.

The properties of precious stones have already been dealt with in a course of Cantor Lectures by Professor H. A. Miers,* and important papers on the subject have been contributed to the Society by Professor A. H. Church,† by Mr. A. Phillips,‡ and by Mr. C. Giuliano.§ I need, therefore, in this lecture say but little regarding the mineralogy and the artistic interest of precious stones. Most of the precious stones have been known from the earliest periods of antiquity. Four magnificent bracelets of gold set with amethyst, turquoise, and lapis-lazuli, to which a date as remote as 5,000 B.C. is assigned, were found by Professor Flinders Petrie in his recent excavations at Abydos. The twelve stones on Aaron's breast-plate, engraved with the names of the twelve tribes, if it were possible to identify them with certainty, would still be regarded as precious. In early times, such stones were highly prized, not only as objects of ornament, but as charms possessing medicinal virtues; indeed the use of precious stones as jewellery appears to have arisen primarily from the magic powers attributed to them, by which they were thought to protect the wearer. Writing in 1644, Boetius de Boodt in his "Histoire des Pierreries," suggests that the substance of the gems, in consequence of their beauty, their lustre, and their dignity, is considered suitable for the dwelling and receptacle of good spirits; and thus when marvellous effects are produced by the precious stones, they should be attributed not to their inherent properties, but to the spirits. The jewellery of primitive people consisted of small stones with natural perforations. Later on, they learned to bore hard stones. As an example, I may mention the perforated chrysolite shown in a drawing in the "Hortus Sanitatis" of 1490. In this work, it is asserted that chrysolite drives away demons and the worst melancholy fears if pierced, and the hole filled up with ass's bristles, and the stone bound on the left arm. Even in pre-historic times precious stones were bored and worn as beads. In Mexico, for example, amazon-stone, chrysoprase, amethyst, red jasper, and brightly-coloured fluorspar were used. In Central Europe, amber was the earliest gem. Soft soapstone, which can be polished with the hand, was also worked into beads.

As a group, precious stones are chiefly distinguished from other minerals by their transparency, lustre, hardness, colour, specific gravity, electric properties, refractive power, and symmetrical crystal form. They are found disseminated through rocks, in veins, fissures or cavities, or in alluvial deposits derived from the disintegration of rocks. The esteem in which precious stones are held for use as personal jewellery does not decrease. Indeed, in the United States, the year 1902 showed the greatest importation on record of precious stones. According to statistics collected for the Government by Mr. G. F. Kunz, the production in the United States in 1902 was as follows:—

	£.
Turquoises	26,000
Sapphires	23,000
Tourmaline	3,000
Quartz-crystal	2,400
Chrysoprase	2,000
Beryl	800
Amethyst	400
Emerald	200
Other stones	5,860
Total	63,660

The following Table indicates the colours, degree of hardness (according to Mohs' scale),

* *Journal of the Society of Arts*, vol. 44, pp. 757, 769.
† *Ibid*, vol. 29, p. 440.
‡ *Ibid*, vol. 35. p. 438.
§ *Ibid*, vol. 37, p. 391.

and specific gravity of the principal precious stones:—

	H.	Sp. Gr.	Colourless.	Red.	Yellow.	Green.	Blue.	Violet	Brown.	Black.
Diamond ...	10	3·5	—		—	—	—		—	—
Ruby	9	4·0		—						
Sapphire ...	9	4·0	—		—	—	—	—		
Chrysoberyl	$8\frac{1}{2}$	3·7			—	—				
Topaz	8	3·5	—	—	—	--	—			
Spinel	8	3·6		—		—	—	—		
Emerald ..	$7\frac{1}{2}$	2·7				—	—			
Zircon	$7\frac{1}{2}$	4·6	—	—	—	—			—	
Garnet	7	3·8		—		—		—	—	—
Cordierite	7	2·6		—		—				
Tourmaline	7	3·1		—		—	—	—	—	—
Quartz	7	2·6	—		—	—		—		
Chalcedony	$6\frac{1}{2}$	3·1								
Opal	6	2·3	—	—	—	—				
Turquoise	6	2·7				—	—			
Nephrite ...	6	3·0				—				
Lapis-lazuli	$5\frac{1}{2}$	2·4					—			
Malachite...	$3\frac{1}{2}$	3·9				—				
Amber	$2\frac{1}{2}$	1·1			—				—	

Diamond.—The diamond is the hardest substance known. It is, however, very brittle. Chemically it is pure carbon; it is combustible, infusible, and unassailable by acids. In the rough form it is devoid of brilliancy and is only semi-transparent. It is usually cut in one of the three forms, termed the brilliant, rose, and table, the first being the best for developing all its beauty. The double-cut brilliant was formerly square with a high crown, but with the advent of the South African stones and the American cutter the brilliants were cut round with a rather flat crown. Recently in America a modification of the rose brilliant forms of cutting with twenty facets, has been patented under the name of 20th century cutting. Besides their use in jewellery and glass-cutting, diamonds have numerous industrial applications. They are used for jewelling watches, 100 or 200 of them, when prepared for this purpose, weighing only one carat ($3\frac{1}{6}$ grains or $205\frac{1}{2}$ milligrammes). Diamond powder is used for drilling and polishing. Mounted diamond points are used for engraving, and the black variety is used for the cutting of millstones, and in the crown of rotatory rock drills. Recent researches have shown that the rays emitted by radio-active bodies induce fluorescence in diamonds. In this way, diamonds can be distinguished from other precious stones. Years ago, the fluorescence of diamonds under the influence of various coloured rays was noted, and Chaumet has ascertained that there is a close relationship between this fluorescent property and the brilliancy of diamonds under artificial light, particularly candle light, which brings out most clearly the quality of first-class stones. The most sparkling stones show a notable fluorescence of a very luminous and clear blue. In a jewel-case in which are grouped diamonds of all qualities, the gems when illuminated by violet light, assume different tints from a vivid blue to sombre violet. As soon as the light removed all derees of phosphorescence are noticeable, the jewel-case appearing to be studded with glow-worms, some very bright, others almost extinct; the most sparkling stone will be found to be the best.

The origin of the diamond has long been a matter of discussion. It seems probable that diamonds have been formed by crystallisation from molten rock masses. Minute crystals of diamond have been found with graphite in slowly-cooled steel, and in meteorites. Mr. E. F. Heneage has arrived at the conclusion that the diamonds of South Africa were formed at a very great depth in the various pipes from accumulations of carbonic acid. The difficulty of reproducing these conditions of great heat and pressure artificially has been overcome by Professor Moissan, who found that iron, at a high temperature and under great pressure, will act as a solvent for carbon, and will allow it to crystallise out in the form of diamond. The diamond is usually found as loose crystals in alluvial deposits, The most important of these deposits are those of India and Brazil. The former deposits were known in very early times, and Golconda was the centre of the diamond trade of the antique world. At the present time the diamond production of India is insignificant. The Brazilian diamonds were discovered in 1728. The provinces of Minas Geraes and Bahia are the most productive. The diamonds are found in alluvial deposits derived from the materials brought down from the hills bordering the higher parts of the valleys. It is estimated that since the opening of the Brazilian mines they have yielded altogether three tons of diamonds. The output in 1902 was 40,000 carats. In Borneo diamonds are found with gold. The production in 1901 was 1,972 carats. Since the introduction of the South African supplies the production has fallen. The famous Borneo diamond, of 367 carats, known as the "Matan," from the territorial title of the Rajah to whom it belongs, has been thought to be the largest known, and was estimated to be worth £269,378. The

Dutch made very large offers of money and warlike material for it early in the 19th century, but they were always refused. The stone, it appears, was examined in 1868, and proved to be only a rock crystal with a specific gravity of 2·63, thus confirming doubts previously expressed as to its being really a diamond. About 95 per cent. of the world's supply of diamonds is produced in South Africa. The diamond mines of the Kimberley field have been described in papers read before the Society by Professor J. Tennant* in 1870, and by Mr. R. W. Murray† in 1880; and in 1893 I read a paper‡ describing a visit to the mines. Since then many changes have have taken place, and a brief account of the development of the industry may not be out of place. The story of the accidental discovery of the diamond fields in 1867 has often been told. The first diggings were river washings, for the existence of diamonds away from the Vaal was not suspected, until, in 1870, garnets were discovered on a Boer farm, and diamonds were looked for. This caused the great rush to Kimberley. The mines were worked as deep, open quarries, the diggers working independently, and a system of aerial ropeways was developed, that made the mines look like a spider's web. In 1879, continued falls of rock from the sides of the excavations, and the constant influx of water, led to the idea of sinking shafts at the side of the quarry, and of reaching the diamond ground by underground galleries. As time went on, excessive competition reduced the price of diamonds to the lowest ebb, and Cecil Rhodes and others associated with him conceived the idea of amalgamating the various companies. The amalgamation was skilfully accomplished, and the De Beers Consolidated Mines, Ltd., acquired control of the diamond trade of the world, the cheque finally paid in 1889 for the shares in the Kimberley Central Company being the largest drawn up to that date. The five mines at Kimberley, the De Beers, Kimberley, Du Toitspan, Bultfontein, and Wesselton, occur in a circle four and a-half miles in diameter. The deposits are evidently the result of the filling-in of extinct craters with volcanic mud from below. The matrix of the diamond, the blue ground, is a breccia composed of shale, basalt, and diorite cemented together by olivine rock. The weathered upper portion of the blue ground is known as yellow ground; and this is what was worked in the early days, the blue ground being then thought to be bedrock. In 1887, Mr. Gardner F. Williams introduced a system of mining in which all the blue ground is removed by overhand stoping from the rock wall farthest from the shaft, the broken surrounding rock being allowed to run in and fill up the stopes. The levels are 40 feet apart, with main levels, from which hoisting takes place, 320 feet apart. The main shaft at Kimberley is 2,160 feet deep.

The winning of the diamonds is an interesting process. The blue ground, deposited from trucks conveyed by endless chain haulage, is harrowed as it lies exposed to the disintegrating action of the sun and rain, on the depositing floors. These have a hard and level surface, and at De Beers cover an area of about two square miles. The blue ground, spread to a thickness of nine inches, lies exposed for about six months before it is thoroughly disintegrated. Even at the end of that time, there is some 14 per cent. of the material that is not acted on, being so hard that it has to be crushed. When the disintegration is complete, the material is hauled to the washing machines, where it is raised by a lift, and passed through a revolving cylindrical screen with $1\frac{1}{4}$ inch holes. The lumps pass out for further treatment, whilst the pulverised blue ground passes into shallow annular pans in which are mounted revolving toothed arms. The diamonds and heavier matter pass to the outside, whilst the lighter waste material flowing towards the centre, is discharged. The entire gear is driven by electric motors. The concentrates are conveyed in locked trucks to the pulsators which are similar to the jigging machines used in ore-dressing. The heavy material obtained, containing the diamonds was, until recently, taken to the sorting tables, the sorting being conducted first when wet by skilled workmen, and again when dry by native convicts. This tedious procedure was done away with by Mr. Kirsten, who invented the automatic diamond sorter termed the "greaser," in which a table built up of five steps covered with a coating of thick grease is vibrated rapidly as the concentrates are allowed to drop on to the top step gradually. The diamonds adhere, whilst the garnets, zircons, mica, magnetite, pyrites, and other minerals are washed off. The diamonds are boiled in caustic soda to clean them. Formerly, out of 192,000 cubic feet of blue ground washed daily at De Beers and Kimberley mines, 160 cubic feet had to be sorted by hand. Now, with the appli-

* *Journal of the Society of Arts*, vol. 19, p. 15.
† *Ibid*, vol. 29, p. 370.
‡ *Ibid*, vol. 41, p. 168,

cation of the greaser, only 1 cubic foot reaches the hand sorting tables. The separated diamonds are taken to the general offices, where they are cleaned by boiling in acid, and sorted for sale. In order to prevent illicit traffic in diamonds and to provide for 12,000 natives employed at the mines, the management has had difficult problems to deal with, which have been solved by keeping the native miners within compounds during the period of the agreement with the company. These compounds, of which there are twelve, consist of rows of iron buildings placed along the sides of a large square, which is surrounded by a 10 foot wall. The largest one at the De Beers mine covers an area of about five acres, and affords accommodation for 2,000 natives. The houses which the natives occupy are clean, lofty, airy tenements, with sleeping bunks arranged somewhat as in large steamers. Sanitary regulations are strictly enforced; and an abundant supply of water provided, roomy washhouses, and a large open swimming bath in the centre of the square; and wash-tanks are everywhere. The compound - square presents an interesting spectacle; hundreds of natives of every shade of black and bronze are scattered about. The stores are stocked with every variety of provisions and necessaries, fresh bread daily, mealies, flour, sardines, potted meats, eggs, oranges, bacon, pipes and cigars, and an abundance of fresh meat. The Kaffirs buy their own provisions and do their own cooking, members of the same tribe frequently clubbing together for this purpose. The compound is also provided with a hospital, dispensary, church, and school.

Fig. 13.

Malacca Diamond Mine, Inverell.

Next in importance to the four great mines of the De Beers Company, to which reference has been made, is the mine at Wesselton, which was not discovered until 1890. It is worked as an open quarry, and yields clear stones of irregular shape. The extent of the operations of

the De Beers Company is clearly shown in the statistics of production for the year ending June 30th, 1902, the output of diamonds having been 2,025,224 carats from blue ground, 202,830 carats from tailings, and 18,728 carats from old concentrates. At De Beers and Kimberley, 2,062,459 loads of blue ground were hoisted, yielding 1,491,012 carats of diamond valued at £3,465,050. The number of carats yielded per load was 0·76, the value per carat being 35s. 6d. The cost of production per load was 8s. 5½d. The Premier mine at Wesselton produced 1,932,140 loads yielding 561,990 carats valued at £941,300. The number of carats per load was 0·30, the value per carat being 33s. 6d. The cost of production per load was 3s. 5d.

In the early days, a good deal of the waste from the mines was used for making up the streets of Kimberley, and, at the present time, the streets are being washed for diamonds, with very remunerative results. Outside Kimberley there are several diamond mines, but none have attained the success of the Kimberley mines. At Jagersfontein, where diamonds were discovered in 1870, the stones are of better quality than De Beers, but the average yield is much less. On the Vaal river, where river washings were extensively carried on; the deposit is similar in composition to that of Kimberley, and is worked as a quarry by two companies. The mineral is screened, and washed and treated on greasers, as at De Beers. The stones are small but of good colour. The most recent development of the South African diamond industry, has been the wonderful discoveries of diamond deposits in the Transvaal, some 25 miles to the east of Pretoria. The production of these deposits in the year 1902-3 was 33,572 carats, valued at £46,358. In August, 1903, alone, at the three mines in the Pretoria district, 14,230 loads were washed, yielding 16,135 carats, valued at £21,676, the average yield being 1·134 carat per load. The following are the principal mining companies in which British capital is invested:—

Name of Company.	Capital issued.	Registered.	Situation of mines.
Brazilian Diamond Field Corporation, Ltd.	£ 8,870	1902	Bahia.
Brazilian Diamond and Exploration Co., Ltd.	60,000	1902	Minas Geraes.
Consolidated Bultfontein Mine, Ltd.	721,500	1888	Kimberley, leased to De Beers.
Diamond Exploration and Finance Syndicate, Ltd.	22,500	1902	
Elandsdrift Diamond Estates	300,000	1901	Barkly West, Cape Colony.
Frank Smith Diamond	250,000	1900	,, ,, ,, ,,
Griqualand West Diamond Mining Co., Ltd	1,057,000	1881	Kimberley, leased to De Beers.
Inverell Diamond Fields, Ltd.	381,307	1900	Mayo, N.S.W.
Kamfersdam Mines, Ltd.	300,060	1896	Cape Colony.
Koffyfontein Mines, Ltd.	220,427	1893	Jacobsdaal, O.R.C.
Lace Diamond Mining Co., Ltd.	250,000	1899	Kroonstad, O.R.C.
Malacca Diamond Mines, Ltd.	105,007	1900	Hardinge, N.S.W.
New Jagersfontein Mining and Exploration Co., Ltd.	1,000,000	1887	Orange River Colony.
New St. Augustine Diamond Mining Co., Ltd.	81,361	1902	Griqualand West.
Orange Free State and Transvaal Diamond Mines, Ltd.	550,000	1894	Kaal Vallei, near Ventersburg.
Otto's Kopje Diamond Mines, Ltd.	488,660	1900	Kimberley.

The existence of diamonds and other gems in New South Wales was recorded as early as 1851, but no systematic attempts to work the deposits were made until 1872, and little success attended the industry until 1890. The diamonds occur in the Inverell and other districts in old Tertiary river drifts. The diamonds are harder and whiter than the South African ones. The majority of diamonds obtained weigh from 1-6th to 1-5th carat, while the largest vary from 2 to 3 carats. The number obtained per load varies very greatly; the Round Mountain Company at Cope's Creek, in the Inverell district, washed 722 loads for 2,685 carats in 1886, obtaining from six loads the exceptional yield of 1,080 diamonds, weighing 296 carats. In 1902, the Inverell Diamond Fields, Ltd., obtained 4,538 carats from 4,640 loads. The total output of New South Wales was 11,995 carats, valued at £1,1326, and the Malacca Diamond Mines, Ltd. (Fig. 13) are now giving regular returns of 1¼ carats of diamonds to the load. Another source of diamond supply is British Guiana, where, in 1901 there were produced 91,286 diamonds, weighing 8,227 carats.

Although known in ancient times, diamonds were for centuries but little used as ornaments. The practice of roughly cutting diamonds is of great antiquity, but it was not until 1456 that Louis van Berghem, of Bruges, discovered the art of cutting into facets. The double-cut brilliant, now the usual form, was introduced by Vincenti Peruggi, of Venice, at the end of the 17th century. The centre of the diamond-cutting industry is Amsterdam, where some 12,000 workmen are employed. Of late years Amsterdam has lost the monopoly it formerly possessed, and more diamonds are cut in New York, London, and Antwerp. The finest stones are those from India. The oldest known and largest, the Great Mogul, was seen by Tavernier in Delhi, in 1665. It was subsequently lost. Its weight was 280 carats, and the uncut stone must have weighed 787 carats. The Orloff diamond (193 carats), mounted in the Russian Imperial sceptre, and the Kohinoor (originally $186\frac{1}{16}$ carats) are also of Indian origin, and similar in form. The latter was recut in 1852 with a reduction in weight to $106\frac{1}{16}$ carats. The most beautiful cut brilliant is the Regent or Pitt diamond in the possession of the French Government, which was recut in London in 1717, and thereby reduced in weight from 410 carats to $136\frac{3}{4}$. The Florentine diamond now in the possession of the Emperor of Austria is $133\frac{1}{5}$ carats in weight and cut in the usual manner. The Nassak diamond, $89\frac{3}{4}$ carats, is of an irregular triangular shape. The Pasha of Egypt diamond weighs 40 carats. Every year we hear of new discoveries in South Africa of diamonds of remarkable size. The largest, the Excelsior, was found in 1893 at Jagersfontein, and weighed $971\frac{3}{4}$ carats. The yellowish De Beers diamond, $428\frac{1}{2}$ carats, gave when cut a brilliant of $288\frac{1}{2}$ carats. Of coloured diamonds, the Hope blue diamond ($44\frac{1}{2}$ carats) and the pale green diamond (40 carats) at Dresden are the most celebrated. The quantity of diamonds the world has produced up to the end of 1901 may be estimated as follows:—

	Carats.
Russia	25
North America	110
British Guiana	20,000
New South Wales	110,000
Borneo and India	300,000
Brazil	15,000,000
South Africa	68,000,000
	83,420,135

or about 17 tons.

Corundum Gems.—India is specially rich in corundum. A large number of localities at which it occurs are mentioned in Mr. T. H. Holland's monograph published by the Geological Survey of India. There are large deposits of the common form of this mineral, emery; and the most highly prized specimens of its transparent red variety, the ruby, have been obtained from Burma, whilst the mines of Kashmir are noted for the size and transparency of the blue variety, the sapphire. Until recently nearly all the known occurrences of corundum were in detrital material. Mr. C. Barrington Brown was the first to prove the existence of the ruby *in situ* in crystalline limestone, and in conjunction with Professor Judd he has published a masterly memoir on the subject in the "Philosophical Transactions of the Royal Society." The most important locality is near Mogok, in Upper Burma. The rubies occur in a clayey mass, an alteration product of a coarsely granular marble. Sapphire, spinel, and tourmaline are also met with. This marble appears to have been derived by contact metamorphism from a dolomite limestone of Upper Carboniferous age. Such limestone still stands unaltered in many places, and in others has been altered into marble by up-bursts of eruptive rock. The clay containing the rubies lies at the side of valleys and fills wide cavities. The stones found are much worn and corroded on the surface. The Burma Ruby Mines Co., Ltd., founded in 1889 with a capital of £150,000, is now, after many difficulties, obtaining very satisfactory results. In the year ending February 28th, 1902, a dividend of $17\frac{1}{2}$ per cent. was paid. During the year 1901 the Company washed 947,444 loads of gem earth at a cost of 10·29d. per load. The production included 210,784 carats of rubies, 9,786 carats of sapphires, and 10,241 carats of spinel. The methods of mining for the ruby in Burma are suited to the three modes of its occurrence in the limestone, in hill detrital material, and in the alluvial deposits in the valleys. In the quarries blasting is unsuitable as it injures the gem stones. The dirt is raised by endless ropes from quarries 50 feet deep. Stones of greater weight than four carats are of such exceptional occurrence that they command fancy prices. The largest known were brought from Burma in 1875 and weighed 37 and 47 carats respectively. They are said to have been sold for £10,000 and £20,000. English cut sapphires under one

carat vary in price from £4 to £12, but the value does not, like that of the ruby, increase enormously in proportion to its size. Mr. G. S. Streeter,* who described the Burma ruby mines, mentions an Indian sapphire weighing originally 225 carats, and worth £7,000 to £8,000. Small rubies and sapphires are largely used for bearings in watches. In the United States alone about 1,200,000 watches with jewelled works are manufactured annually, requiring 12,000,000 jewels, of which 5,000,000 are ruby and sapphire, the remainder being garnets. Rubies and sapphires were obtained to the value of about £3,701 in 1902 from shallow diggings in Siam. Small quantities of sapphires are also obtained from alluvial workings in Ceylon. At Anakie, Queensland, in 1902, some £5,000 worth of sapphires were raised. Sapphire, corundum, and emery are of frequent occurrence in the United States. In Montana sapphires are largely mined; they occur in an eruptive dyke in limestone. The various localities are enumerated by Mr. J. H. Pratt in a recent report to the United States Geological Survey. Sapphires are not in great demand for the moment chiefly because they do not appear to advantage in artificial light, but seem dark and dull. In experimenting on the action of various rays on rubies, Chaumet ascertained that the Siamese stones are of scarcely appreciable fluorescence under violet light, while all the valuable Burmese rubies are intensely fluorescent.

Emery, the common form of corundum, is found in large quantities in the Island of Naxos, and the mines are the property of the Greek Government. The Naxos emery is superior to that of Asia Minor owing to its great density, and the greater fineness and hardness of its grain. It fetches 112 to 115 francs a ton. The world's consumption of emery is 25,000 tons annually, of which Asia Minor supplies some 18,000 tons, valued at £53,000; Canada 388 tons, valued at £10,914; and Naxos 6,328 tons, valued at £26,830.

Owing to the great value of the ruby, other stones are frequently described as such in commerce, notably the deep red spinel or the pale rose tinted Balas ruby, which is composed of alumina and magnesia, coloured by iron or chromium. When of fine colour it is a valuable stone. Spinels are derived chiefly from Ceylon, where they are found in alluvial deposits. Red tourmaline is sold as Siberian ruby, and garnet is sometimes passed off as ruby. Topaz of a pink colour is sold as Brazilian ruby. Similarly cyanite, a silicate of alumina, found in Brazil and India in blue crystals, and cordierite, found in blue crystals in Ceylon, and characterised by its dichroism, are sometimes sold as sapphires.

Emerald.—Emerald is rarely found in detrital material, but usually *in situ* in mica schist or limestone. Beryl, aquamarine, and emerald are silicates of aluminium and glucinum. The deep green emeralds have now become scarce and have greatly increased in public favour. The beryl is fairly abundant. The less transparent stones are of no great value, but occur in masses of large dimensions in many localities in the United States; the finest are from Siberia, Madras, and Brazil. The celebrated emerald locality in Norway was recently taken up by the Norwegian and General Exploitation Company, Ltd. (capital issued £75,000). Quantities of beryl have been found, but no valuable emeralds.

In the Republic of Colombia the Muzo Mine, recently offered for sale, has been famous since the year 1555, for the production of the finest emeralds of the world. The mode of working is similar to that adopted in Europe in large quarries. The top soil is removed by washing until the slate rock is left bare, this being cut away by means of long bars, and with the aid of blasting. The stones are found chiefly in pockets, but occasionally some are found isolated from the veins. The large amount of *débris* resulting, is carried away by means of discharges of water from reservoirs at an elevation above the workings, by means of syphons. The stones, after extraction, are classified into six qualities. The greater quantity are forwarded to British India to be cut, and afterwards the better qualities return to the markets of Europe for sale. The decrease in the world's output of emeralds during the past few years has been such as to cause grave concern among the precious stone dealers. Unless new mines are discovered soon, it is not unlikely that emeralds will become the rarest precious stones in the world. As the condition of the market is now, they are worth (in stones larger than five carats) from two to ten times as much as diamonds. Several stones now in the hands of New York dealers are worth from £3,000 to £10,000 apiece. They range from ten to thirty carats in size, and are not free from imperfections.

There are several precious stones of a green

* *Journal of the Society of Arts*, vol. 37, p. 266.

colour that are sometimes sold as emeralds. The more important of these is chrysolite or periodot, a silicate of magnesia coloured green by iron. It is of a soft green colour. Fine examples exist in various church treasures collected probably during the Crusades, but the original locality of these gems in unknown. The common form of the mineral (olivine) is abundant in eruptive rocks. Hiddenite, a silicate of aluminium and lithium, found in North Carolina, is much esteemed in America, under the name of lithium emerald. Tourmaline, when of a dark green colour is sold as Brazilian emerald. It is, however, easily recognised by its dichroism.

Opal.—Opal consists of hydrated silica. It owes its peculiar play of colour to the numerous irregular fissures traversing it, which contain laminæ that reflect the rays of different colours. The finest opals formerly came from Hungary, Mexico, and Honduras, where they occur in igneous rocks. In Hungary, the opal mines at Dubnik are mined by the State. The opal occurs lining open fissures in pyroxene-andesite. The opals are sorted into four classes. The undertaking affords employment to 140 workmen, and yields about 12,000 carats annually. In 1889 a rich vein was found, and the yield was 28,000 carats. Australia is now the chief source of production of precious opal. The rich opal fields of White Cliffs, New South Wales, was discovered by a mere accident, in 1889, and since then opal mining has become an important industry. The mineral occurs in seams in Cretaceous deposits, and varies in value from very little up to £25 an ounce, the unit of purchase in the rough. A specimen recently found, weighing 13 lbs., was a solid mass of gems. The value of the opals raised in New South Wales in 1902 was £140,000. In Queensland, the workings cover a wide district, having been traced from Eulo, in the Gunnamulla district, about 150 miles north of Bourke, in New South Wales, for some 500 miles in a north-westerly direction as far as Winton, in the county of Ayrshire. The precious opals met with occur here and there in patches in upper Cretaceous sandstones and clays. In places the mineral is found scattered over the surface, being set free by denudation, but such occurrences furnish little evidence of precious opal below. The average depth of the shafts is 14 feet, and the deepest is about 65 feet. The great difficulty in the progress of the industry is the scarcity of water, the annual output being dependent on the rainfall. The value of the Queensland production in 1902 was £7,000. Mr. G. F. Kuntz declares that more opals are sold in a year than were sold in fifty years before the Australian mines were opened. The beauty united to the low price and abundance of much of the opal won makes it available for all kinds of decorative effects in the jeweller's art. Of precious opal, the finest, from Czerwenitza, Hungary, is in the celebrated bouquet of gems presented by the Empress Maria Theresa to her Consort. It is now in the Vienna museum. It weighs 594 grammes and is valued at £160,000. Central America and Mexico are also said to be producers, and occurrences have been noted in Tasmania. The most important point in buying opals is colour. Red is in the keenest demand, or red in combination with yellow, blue, and green. Pattern is a secondary consideration in valuing the stone. Harlequin is the rarest of all, and when the colour squares of red, yellow, blue and green are regular and distinct, its beauty is remarkable. The flash opal, though not so rare as the harlequin, is scarcely less attractive, particularly when its colour veins are of the true ruby or pigeon's blood hue.

Turquoise.—Turquoise is of a bright blue to greenish blue colour but opaque. The most valuable stones are azure blue with a resinous lustre, taking a high polish. The colour gradually fades on exposure to sunlight. The gem was appreciated even in the time of Pliny. It is a phosphate and hydrate of alumina coloured by copper. It occurs in small reniform masses in Persia and Arabia. The celebrated turquoise mines of Persia are situated in a mountainous region 6,000 feet above sea level. They employ 1,500 persons. Many of the mines are mere burrows. Turquoise mining is now active in the United States where the gem is in great favour. Turquoise has also been found in the Murchison district, Western Australia, and deposits are being worked in Egypt. Odontolite, frequently sold as an inferior turquoise, is fossil bone coloured by copper.

Garnet.—Gems of the garnet group are obtained in great abundance. The varieties most esteemed are the violet-coloured almandine or precious garnet, the brownish-red or carbuncle, usually cut *en cabochon*, the yellowish-brown cinnamon stone, and the pyrope or Bohemian garnet. The hilly Cretaceous district of North-East Bohemia for many years supplied the world's market with garnets, but the South African garnets, a by-product in diamond mining, have caused the abandonment of nearly all the Bohemian

mines except the extensive open-workings at Podseditz, where the Pleistocene drift containing the garnets is nine feet or more in thickness, and lies a couple of feet below the surface. Gem garnets of great beauty have been discovered in the Cowee valley, in North Carolina, the yield in 1901 being 200,000 carats, valued at £4,000 after cutting. In the same year the United States produced 4,444 tons of garnets, for abrasive purposes, valued at £31,600.

Other Precious Stones.—Chrysoberyl is a beautiful greenish-yellow precious stone of great rarity. It is the third hardest in the series and consists of alumina and glucina. It occurs in the form of rolled pebbles in Brazil and Russia. Cut *en cabochon*, the less transparent specimens give one of the stones termed by jewellers "cat's eye." Zircon, hyacinth, and the green-coloured jargoon, are silicates of zirconia. They are the heaviest of all precious stones, and occur embedded in granite, basalt, and lava, and in alluvial beds in Ceylon. The topaz is a fluosilicate of aluminia, usually of a yellowish-brown colour, sometimes pale blue. The best come from Brazil. Topaz is found in veins in granite and in the form of rolled pebbles. The transparent moonstone, mined in the Kandy district of Ceylon, the apple-green amazon stone, the Norwegian sun-stone, and the iridescent labradorite, are forms of felspar owing their value as ornamental stones to certain effects of light.

Ornamental Stones.—Of the pure siliceous minerals used as ornamental stones, there are the crystalline transparent forms of silica, the pure colourless rock-crystal, the purple amethyst, the yellow citrine, the brown cairngorm, and the pink rose-quartz, together with the amorphous, translucent, or opaque forms, the white chalcedony, the red carnelian, the deep reddish-brown sard, the green chrysoprase, and the olive-green plasma. The banded variety of chalcedony is agate; when the bands of colour lie in even planes it is termed onyx; or, with alternating bands of red and white chalcedony, sardonyx. For purposes of ornament, the colour of most of these stones is frequently modified by staining, a process practised even in the time of Pliny. In moss agate, and mocha stone, the moss-like markings are due to manganese oxide. Of the opaque variety, jasper, there are several forms, ribbon jasper, with the colours in stripes, Egyptian jasper found in rolled pebbles, with the brown colours in concentric zones, and bloodstone or heliotrope, a jasper of deep green colour, with blood-red spots. Quartz, either fibrous or with some enclosed fibrous body, constitutes a variety of cat's-eye, which has a peculiar lustre. The so-called crocidolite, which first came to Europe from Cape Colony in 1870, is a fibrous form of quartz of rich brown colour. It was formerly exceedingly rare, but is now obtained in considerable quanties. In 1901, the production was 3 tons valued at £150. The brilliantly spangled aventurine is quartz with disseminated particles of mica.

Brazil is the principal source of supply of amethysts. Recently, an immense amygdaloidal cavity lined with amethyst, was found, surpassing anything of the kind previously known. It measured 33 feet in length, 16½ feet in width, and 10 feet in height, and weighed about 35 tons. It was put together to form the Amethyst grotto that was one of the attractions of the Düsseldorf Exhibition of 1902.

The centre of the agate cutting industry is at Oberstein in Germany, where the river Idar in its descent to the Nahe presents a succession of falls through a distance of 24 miles and supplies power for some 60 polishing works. Precious and semi-precious stones are received for polishing from all parts of the world, and the development of the industry has necessitated the use of steam-engines and electric motors in place of the water power originally employed. The agates are ground on sandstone wheels: the workman lying horizontally presses the agate against the grindstone, obtaining purchase by pressing his feet against a block fixed to the floor. (Fig. 14). An important branch of the industry is the preparation of blanks for cutting onyx cameos in Paris and Italy. The cameos are usually cut on stones that have layers of different colours, so that the design appears in white on a red, brown, or black ground.

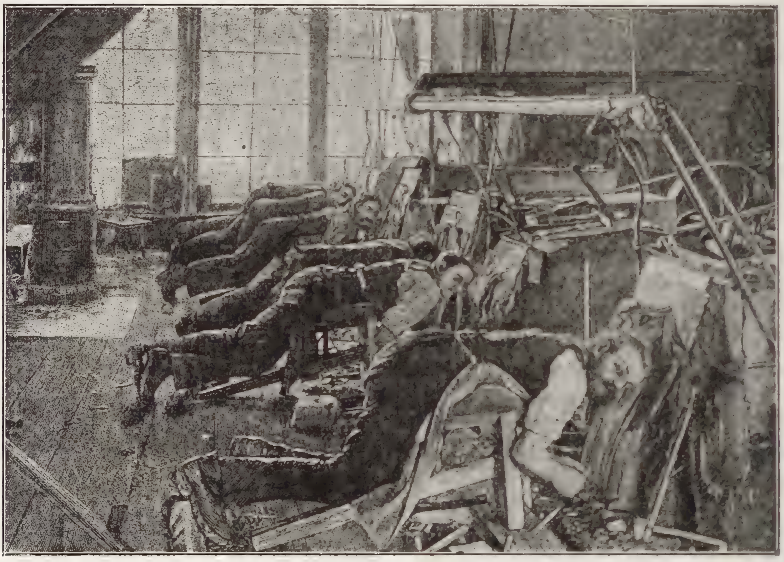
The finest example of sardonyx cameo is in His Majesty's collection at Windsor Castle. It measures 7½ by 5⅞ inches, and is cut upon a rich Oriental sardonyx of four strata. It is a contemporary portrait of the Emperor Claudius. The ground is in the dark brown stratum, the laurel wreath and front of the cuirass in the honey-brown, and the head and hair in the white. The whole is surrounded by a raised border enriched with moulding cut in the thickness of the stone. The most important cameo in existence is the "Gemma Augustea" (Fig. 15) in the Art Historical Museum in Vienna. It is cut upon sardonyx of two layers,

the figures being cut in the bluish-white layer, while the dark forms the background. It measures $7\frac{1}{4}$ by $8\frac{3}{4}$ inches. The design represents Tiberius before his splendid triumph, 12 B.C., descending from his chariot, with Germanicus standing at his side, to present himself to his father Augustus who is seated with the emblems of Jupiter, by the side of the godess Rome. The figures at the base represent captive Germans, and Roman soldiers erecting a trophy. The process of cameo-cutting, and some of the best examples, have been described by Mr. J. B. Marsh * and by Mr. C. Davenport.† The celebrated so-called Mexican onyx, the occurrence of which has been described by Mr. W. Eassie,‡ is in reality an aragonite stalagmite. This rich ornamental stone is largely quarried.

Jade.—Under the name of jade are included two minerals, nephrite and jadeite, closely similar in appearance and properties. It was found by Damour, in 1865, that the former is a silicate of alumina, lime, and magnesia, and the latter a silicate of alumina and soda. These tough minerals are mostly found in detrital deposits. Even now but a few localities are known where they occur *in situ*. In Europe the only one is at Jordansmühl in Silesia, where nephrite forms narrow veins in serpentine. In East Turkestan it was worked by fire-setting, and it occurs in considerable quantities in Siberia. Greyish-green jade is known *in situ* on Monte Viso in Italy, and in Burma. The Maoris still use nephrite for tools, the mineral having recently been discovered for the first time *in situ* in New Zealand, in serpentine, on D'Urville Island. Large bodies of jade-stone are found near Hsu-Yen, on the river Ta-Yang, that empties in the bay of Corea. In many localities these minerals have been found only in worked pieces. In Mexico and Central America jadeite only is found, not nephrite whilst amongst the jades of the north-west coast of America, Siberia, and New Zealand, jadeite has not been recognised. The most remarkable specimen of jadeite known is a Mexican adze with a grotesque human figure carved on its face. It weighs 229 ozs., and is now in the New York Museum. It has been described by Mr. G. F. Kunz, who, in a recent paper, discusses the question, whence the jade so highly prized in Mexico and Central America by the primitive people was obtained. The problem is of great interest to archeologists, and its solution might give to the world a beautiful ornamental stone.

Amber.—Since the times of the Etruscans the Greeks, and the Romans, amber has been obtained from East Prussia, which is still the

FIG. 14.



AGATE POLISHING. (Professor M. Bauer).

* *Journal of the Society of Arts*, vol. 35, p. 147.
† *Ibid*, vol. 49, p. 141.
‡ *Ibid*, vol. 24, p. 503.

chief source of supply. The Prussian Government has a monopoly of the industry. The fossil resin was first found washed up by the water from a submarine bed of Tertiary age, extending along the shores of the Baltic to Cromer on the Norfolk coast. This sea amber is characterised by the fact that it has no weathered exterior. After storms, large quantities are washed ashore and collected. It is also collected in nets, and since 1869 divers have been successfully employed by the Königsberg firm of Stantien and Becker, to collect amber from the bottom of the sea and to dig it out. More than twenty large steam dredgers are in use raising the material from a depth of 7 to 11 yards. Quarries are also worked near the sea-shore, and every year

FIG. 15.

GEMMA AUGUSTEA.

a large proportion of the amber production is obtained in this way. The greyish-blue sandy clay, known as blue earth, containing the amber, is opened up by quarrying and by ordinary mining. The principal workings are about mid-way between Memel and Dantzig, the largest mine being at Palmnicken, where the blue earth is 16 feet thick. The mine galleries have a total length of 150 miles, and the annual yield of amber is about 200 tons. The amber is separated from the enclosing earth by washing on coarse screens with a powerful jet of water. The cleaned amber is finally sent to Königsberg, where it is sorted for the market into nearly a hundred different varieties. The flat pieces of amber are turned for smokers' requisites, and the round pieces cut in facets or worked into beads for bracelets and necklaces. The pieces of amber can be softened in boiling linseed oil, and the cloudy specimens rendered clear. The small impure amber is used for the manufacture of varnish. The total annual consumption of the world of crude amber represents a value of about £150,000. Many imitations of amber are manufactured, and compressed amber, or ambroid, made by compressing small pieces at great pressure and high temperature, is largely utilised. The income derived by the Prussian Government from the amber industry amounted in 1811 to £1,100 annually, and rose in 1895 to £35,500. The mineral is State property, but, as a matter of fact, the working and sale was leased to the firm of Stantien and Becker for many years. On July 1st, 1899, the Prussian Government purchased the whole of the works of this firm, and started to mine and trade on the State account. The purchase price was £487,500. Details of the various uses of amber are given in a paper read by Mr. P. L. Simmonds.* Amber is obtained in irregular masses, usually of small size. A single enormous piece of amber, weighing nearly 7 lbs., was found a few years ago, by some fishermen at Langlutjensand. The largest piece on record, 18 lbs., is in the Berlin Museum.

Other Ornamental Stones.—Among other ornamental stones are the comparatively soft green malachite (carbonate of copper) and the azure blue lapis lazuli, a complex combination of silicate and sulphate, which was formerly powdered and washed to make the ultramarine of the artist. The richer varieties are used in mosaic, and for costly vases and jewellery. Steatite, or soap-stone, is used by the Chinese for carving figures. Jet, a variety of lignite, the Gagates of the ancients, is largely used for mourning ornaments. In England, jet mining is not pursued as a regular occupation, in the cliffs near Whitby a little burrowing is done in stormy weather when agricultural work is difficult. The manufacture of Whitby jet was described in 1873 by Mr. J. A. Bower.† Of late years the trade has died out. Comprehensive descriptions of the different precious and ornamental stones will be found in Mr. G. F. Kunz's well-known work on the precious stones of the United States, and in Professor Max Bauer's "Edelsteinkunde," of which an English translation by Mr. L. J. Spencer is announced.

The Rare Earths.—In the early days of chemistry the term "earth" was applied to certain substances now known to be oxides of

* *Journal of the Society of Arts*, vol. 18, p. 180.

† *Ibid.*, vol. 22, p. 80.

metals, which were distinguished by being infusible at a high temperature. On account of the scarcity and infusibility of the oxides of the cerium and yttrium groups, the old term is still made use of, and they are known as the "rare earths." From the discovery of yttria by Gadolin in 1784, until recent years, these rare earths were solely of chemical interest. When, however, the system of incandescent gas lighting, invented by Auer von Welsbach, came before the public in 1886, the rare earths at once acquired industrial importance, and eager search was made for minerals containing them in all parts of the globe. Briefly described, Welsbach's process consists of impregnating a cotton tube with a solution of the nitrates of the rare earths, whilst the upper end is further impregnated with a strengthening solution. The chief sources of the rare earths are the minerals allanite, orthite, gadolinite, xenotime, euxenite, yttrotantalite, fergusonite, tyrite, cerite, and zircon. Although the standard works on mineralogy give a long list of localities at which specimens of these rare materials have been found, the supply is very limited, and they are in consequence very expensive. Moreover, they do not contain appreciable quantities of the most active element for incandescent gas lighting purposes, thoria. The chief source of thoria is monazite, a mineral occurring in large quantities in Brazil, Norway, the Ural, Carolina, and Canada. Monazite is an anhydrous phosphate of the rare earths, cerium, lathanum, and thorium. It was first discovered in 1823, and it was subsequently found to be identical with numerous new minerals discovered in various localities, and receiving various names. The name that has survived was given to it by Breithaupt, in 1829, from the Greek verb, meaning to live alone, owing to the fact that at Mount Ilmen, in Siberia, it was met with in solitary tabular prisms. The translucent crystals are of a red or yellow colour, with a hardness nearly equal to that of felspar, and a specific gravity of 4·6 to 5·3. They vary in size from microscopic dimensions to 5 in. in length, in the case of those found in Amelia Country, Virginia. Irregular masses of monazite showing crystalline structure, and weighing 15 to 20 lbs., and rounded masses weighing 12 lbs., have been found at the mica mine of Villeneuve, in Quebec. The mineral contains 20 to 29 per cent. of phosphoric acid, 28 to 37 per cent. of ceria, 14 to 31 per cent. of lathana, 0 to 1·8 per cent. of yttria, and 2 to 18 per cent. of thoria. Monazite, or its varieties, is met with in many places. It usually occurs in granite. These deposits, however, have chiefly a mineralogical interest. Those of commercial value represent the product of the decomposition and disintegration of rocks that originally contained monazite. The first monazite sands to be utilised were obtained by the eminent mineralogist, Mr. W. E. Hidden, in considerable quantity in 1879, in the gold placers of Carolina, in association with platinum. In 1884, Hidden succeded in inducing the Welsbach Light Company to experiment with monazite, with a view to extracting from it the rare earths it contains, and to substituting thoria for zirconia in the manufacture of the mantles for incandescent gas lighting. The Brazilian deposits occur as beach sea sands, and their concentration has been effected by the action of the waves. In the pegmatite dykes of southern Norway, monazite occurs in large crystals. In the United States the workable deposits of monazite sands are confined to Carolina, and cover an area of 1,600 to 2,000 square miles. Their thickness varies from one foot to two feet, and their monazite contents are very variable, ranging from an infinitesimal proportion up to one to two per cent. The mining of monazite consists merely in washing the sands in sluice boxes, similar to those employed in alluvial gold mining. The sluice boxes measure 8 feet in length, 20 inches in width, and 20 inches in depth. Two men work at a box, one charging the gravel on a perforated plate at the upper end, and the other working the contents up and down with a fork or perforated shovel, so as to cause the lighter sands to float off. The boxes are cleaned out at the end of the day's work. Magnetite, if present, is eliminated from the dried sand by treatment with a large magnet. Many of the heavy minerals, such as zircon, rutile, corundum, garnet, &c., can be completely eliminated. A cleaned sand containing 65 to 70 per cent. of monazite is considered of good quality, According to Mr. H. B. C. Nitze, from 20 to 35 lbs. of cleaned monazite sand per man is a good day's work. The cost of labour is 3s. per day. In South Carolina, better methods of mining and cleaning are used, and a richer product is obtained. Various classes of sand are produced, the best containing 85 per cent. of monazite. The South Carolina production, however, represents only a small proportion of the output of the United States, for the mines are much less important than those of North

Carolina. In some exceptional cases it is possible to extract with profit the monazite from the containing rocks *in situ*. For example, in Cleveland County, North Carolina, at the Phifer Mine, hillside mining is resorted to in the case of a micaceous gneiss, in which crystals of monazite occur. The production of monazite is very irregular, but at the present time the market easily absorbs all that is produced. The highest price recorded was in 1887, when it was 1s. per lb., but it fell suddenly to 2½d. At the present time prices vary from 2d. to 4d. per lb., with a proportion of thoria varying from 2 to 6 per cent. The production of the United States in 1901 was 748,736 lbs., valued at £11,852. The production of Brazil was 1,643 tons, valued at £23,937. The production in Australia, Siberia, and Norway is considerably less.

Conclusion.—I regret that owing to the difficulty of showing specimens to a large audience, it has been found necessary to confine the illustrations of these lectures to lantern photographs. Specimens of the various minerals to which reference has been made can be examined in many public collections, notably at the Natural History Museum and the Museum of Practical Geology in London, in the United States National Museum at Washington, and in the Natural History Museum in Vienna. A visit to the mineralogical collections of the museums mentioned is rendered specially instructive by the scholarly guides that have been prepared by Mr. L. Fletcher, by Mr. F. W. Rudler, by Mr. G. P. Merill, and by the Ritter von Hauer, respectively. Well arranged collections of Indian and Colonial mineral products may be studied at the Imperial Institute, while for the St. Louis Exhibition of 1904 the Home Office authorities are preparing a representative collection illustrating the mineral resources of the United Kingdom, on the same lines as that formed by the Council of the Society of Arts for the Chicago Exhibition of 1893.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock:—

JANUARY 20.—"Organ Design." By THOMAS CASSON. T. H. YORKE TROTTER, Mus.Doc., will preside.

JANUARY 27.—"Ice Breakers and their Services." By ARTHUR GULSTON. DR. FRANCIS ELGAR, P.R.S., will preside.

FEBRUARY 3.—"Steam Cars for Public Service." By THOMAS CLARKSON, M.I.Mech.E. LIEUT.-COL. H. C. L. HOLDEN, R.A., F.R.S., will preside.

FEBRUARY 10.—"Thermit." By CHARLES VERNON BOYS, F.R.S.

FEBRUARY 17.—"Garden Cities in their relation to Industries and Agriculture." By A. R. SENNETT.

FEBRUARY 24.—"Mahogany and other Fancy Woods available for Constructive and Decorative Purposes." By FRANK TIFFANY.

Dates to be hereafter announced:—

"Lessons to be Learnt from the Fire Brigade Appliances at the late International Fire Exhibition." By EDWIN O. SACHS.

"Artificial and other Building Stones." By L. P. FORD.

"Early Painting in Miniature." By RICHARD R. HOLMES, C.V.O.

"Mechanical Piano Players." By J. W. COWARD.

"Agricultural Education." By J. C. MEDD.

"Motor Cars for popular use." By MERVYN O'GORMAN, M.Inst.E.E.

"Physical Degeneration." By ROBERT JONES, M.D., B.Sc., F.R.C.S.

INDIAN SECTION.

Thursday Afternoons, at 4.30 o'clock:—

FEBRUARY 11.—"Our Commercial Relations with Afghanistan." By COLONEL SIR THOMAS HUNGERFORD HOLDICH, R.E., K.C.M.G., K.C.I.E., C.B., Member of Council. The Right Hon. SIR J. WEST RIDGEWAY, G.C.M.G., K.C.B., K.C.I.E., will preside.

MARCH 10.—"China Grass: its Past, Present, and Future." By FRANK BIRDWOOD, B.A. PROF. SIR WILLIAM RAMSAY, LL.D., F.R.S., will preside.

COLONIAL SECTION.

Tuesday afternoons, at 4.30 o'clock:—

FEBRUARY 9.—The Biology of Federation." By the Hon. SIR JOHN ALEXANDER COCKBURN, K.C.M.G.

[Members will please note that the date of this meeting has been changed from the 2nd to the 9th of February.]

MARCH 1.—"Nigeria." By LADY LUGARD (Miss Flora L. Shaw). The DUKE OF MARLBOROUGH, K.G., Under-Secretary of State for the Colonies, will preside.

MARCH 22.—"Cotton Growing in the British Empire." By ALFRED EMMOTT, M.P.

APPLIED ART SECTION.

Tuesdays, at 4.30 or 8 o'clock:—

JANUARY 19, 8 p.m.—"Celtic Ornament." By GEORGE COFFEY. LEWIS FOREMAN DAY, Vice-President of the Society, will preside.

FEBRUARY 16.—

MARCH 15, 4.30 p.m.—"Recent Developments in Devonshire Lace-making." By ALAN S. COLE, C.B.

CANTOR LECTURES.

Monday evenings, at 8 o'clock :—

J. LEWKOWITSCH, PhD., M.A., F.I.C., "Oils and Fats—their Uses and Applications." Four Lectures.

LECTURE I.—JANUARY 25.—Extent of the Oil and Fat Industries—Sources of Supply—Raw Materials—Modern Methods of Manufacture.

LECTURE II.—FEBRUARY 1.—Methods of Refining — Bleaching — Demargarinating Processes—The Industry of Edible Oils and Fats—Butter Substitutes —Lard Substitutes—Chocolate Fats.

LECTURE III.—FEBRUARY 8.—Burning Oils—Paint Oils—Lubricating Oils—Blown Oils—Boiled Oils—Varnish Industry—Linoleum Industry—Vulcanised Oils—Turkey red Oils—Modern Theory of Hydrolysis of Fats.

LECTURE IV.—FEBRUARY 15.—Modern Processes of Saponification—Candle Industry—Soap Industry —Manufacture of Glycerine—Recovery of Glycerine from Soap Lyes.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, JAN. 18...British Architects, 9, Conduit-street, W., 8 p.m. Mr. J. Starkie Gardner, "Architecture in Lead."

Camera Club, Charing-cross-road, W.C., 8¼ p.m. Mr. Egerton Castle. "The Romance of Swordsmanship."

London Institution, Finsbury-circus, E.C., 5 p.m. Mr. M. H. Spielmann, "British Sculpture of To-day."

TUESDAY, JAN. 19...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Applied Art Section.) Mr. George Coffey, "Celtic Art."

Royal Institution, Albemarle-street, W., 5 p.m. Prof. L. C. Miall, "The Development of Animals." (Lecture II.)

Civil Engineers, 25, Great George-street, S.W., 8 p.m. 1. Discussion on Mr. Alexander Millar's paper, "The Electrical Re-Construction of the South London Tramways on the Conduit System." 2. Mr. Alfred Edward Carey, "The Sanding-up of Tidal Harbours."

Statistical, 9, Adelphi-terrace, W.C., 5 p.m. Mr. Thomas A. Welton, "The Smaller Urban Districts of England and Wales."

Pathological, 20, Hanover-square, W., 8½ p.m.

Zoological, 3, Hanover-square, W., 8½ p.m. 1. Mr. Guy A. K. Marshall, "A Monograph of the Coleoptera of the Genus *Hipporhinus*." 2. Dr. Walter Kidd, "Proposed Additions to the accepted Systematic Characters of certain Mammals." 3. Dr. W. G. Ridewood, "Some Observations on the Skull of the Giraffe."

WEDNESDAY, JAN. 20...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. T. Casson, "Organ Design."

Meteorological, 25, Great George-street, S.W., 7¾ p.m. Annual General Meeting. Address by the President (Capt. D. Wilson-Barker), "The Present State of Ocean Meteorology."

Geological, Burlington house, W., 8 p.m.

Chemical, Burlington-house, W., 5½ p.m. 1. Mr. H. O. Jones, "Optically active asymmetric nitrogen compounds *d*- and *l*-phenylmethylethylbenzylammonium salts." 2. Messrs. J. Dewar and H. O. Jones, "The chemical reactions of nickel carbonyl, Part I.: Reactions with the halogens, etc." 3. Messrs. J. Dewar and H. O. Jones, "The chemical reactions of nickel carbonyl, Part II.: Reaction with aromatic hydrocarbons in presence of aluminium chloride—Synthesis of aldehydes and anthracene derivatives." 4. Mr. G. Barger, "A microscopical method of determining molecular weights." 5. Messrs. E. R. Needham and W. H. Perkin, junr., "*o*-Nitrobenzoylacetic acid." 6. Messrs. W. H. Perkin, junr., and Miss A. E. Smith, "The cis- and trans- modifications of $\alpha\alpha\gamma$ trimethylglutaconic acid." 7. Messrs. J. B. Cohen and J. Miller, "The influence of nuclear substitution on the rate of oxidation of the side-chain, I. Oxidation of the mono- and di-chlorotoluenes." 8. Prof. T. E. Thorpe, "A simple thermostat for use in connection with the refractometric examination of oils and fats." 9. Prof. T. E. Thorpe, "The interdependence of the physical and chemical criteria in the analysis of butter-fat." 10. Messrs. A. W. Titherley and J. F. Spencer, "The condensation of furfuraldehyde with sodium succinate."

Microscopical, 20, Hanover-square, W., 8 p.m. Presidential Address by Dr. Woodward, "The Evolution of Vertebrate Animals in Time."

Entomological, 11, Chandos-street, W., 8 p.m. Annual Meeting. Address by the President, Prof. E. B. Poulton.

British Archæological Association, 32, Sackville-street, W., 8 p.m.

Sanitary Engineers, 19, Bloomsbury-square, W.C. 7 p.m. Presidential Address by Mr. W. H Maxwell.

THURSDAY, JAN. 21...Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Linnean, Burlington-house, W., 8 p.m. 1. Dr. G. H. Fowler, "An Account of a Plankton Expedition to the Bay of Biscay in H.M.S. *Research*, in 1900." 2. Rev. T. R. R. Stebbing, "The Crustacea obtained by Dr. G. H. Fowler, in the Biscayan Plankton."

London Institution, Finsbury-circus, E.C., 5 p.m. Prof. Hans Wessely, "Violin Music from the Old Italian Masters to the Modern Composers."

Royal Institution, Albemarle-street, W., 5 p.m. Mr. G. R. M. Murray, "The Flora of the Ocean." (Lecture II.)

Optical, 20 Hanover-square, W., 8 p.m. Prof. R. T. Glazebrook, "The Optical Society and the National Physical Laboratory."

Numismatic, 22, Albemarle-street, W., 7 p.m.

Camera Club, Charing-cross-road, W.C., 8½ p.m. Dr. von Reckenhausen, "Mercury Vapour Lamps and their Application to Photography."

FRIDAY, JAN. 22...Royal Institution, Albemarle-street, W., 9 p.m. Rev. W. Sidgreaves, "Spectroscopic Studies of Astrophysical Problems at Stonyhurst College Observatory."

Architectural Association, 9, Conduit-street, W., 7½ p.m. Mr. Maurice B. Adams, "The Making of Architects—with Examples of Draughtmanship."

Clinical, 20, Hanover-square, W., 8½ p.m.

Physical, at the Royal College of Science, Exhibition-road, South Kensington, S.W., 5 p.m. 1. Mr. S. Skinner, "The Photographic action of Radium Rays." 2. Mr. W. Bennett, "Astigmatic Aberration." 3. Prof. R. W. Wood, "Some new cases of Interference and Diffraction." 4. Messrs. Crompton and Co., Exhibition of Instruments.

SATURDAY, JAN. 23...Royal Institution, Albemarle-street, W., 3 p.m. Mr. J. A. Fuller Maitland, "British Folk Song" (with vocal illustrations). (Lecture II.)

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FRIDAY, JANUARY 22, 1904.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

NEXT WEEK.

MONDAY, JANUARY 25, 8 p.m. (Cantor Lectures.) J. LEWKOWITSCH, Ph.D., M.A., F.C.S., "Oils and Fats—their Uses and Applications." (Lecture I.)

WEDNESDAY, JANUARY 27, 8 p.m. (Ordinary Meeting.) ARTHUR GULSTON, "Ice Breakers and their Services."

Further details of the Society's meetings will be found at the end of this number.

SWINEY PRIZE.

A meeting of the adjudicators of this prize, appointed by the will of the late Dr. Swiney, was held at 4.30 p.m., on Wednesday, January 20, 1899, at the Society of Arts. The LORD CHIEF JUSTICE, G.C.M.G., Vice-President of the Society, was in the chair.

The Secretary read the advertisement convening the meeting.

The Secretary read a report from the joint Committee of the Society of Arts and the College of Physicians, recommending that the prize should be awarded to Sir Frederick Pollock and Mr. F. W. Maitland, for their book, "History of English Law before Edward the First."

It was thereupon moved by the Lord Chief Justice, seconded by Sir William Church, Bart., K.C.B., President of the Royal College of Physicians, and resolved, "That the prize be adjudged to Professor Sir Frederick Pollock, Bart., LL.D., D.C.L., and Professor Frederic William Maitland, LL.D., D.C.L., authors of a published work on the 'History of English Law before Edward the First.'"

APPLIED ART SECTION.

Tuesday evening, January 19, 1904; LEWIS FOREMAN DAY, Vice-President of the Society, in the chair. The paper read was on "Celtic Ornament," by GEORGE COFFEY, Keeper of Irish Antiquities, Dublin.

The paper and report of the discussion will be published in a future number of the *Journal.*

CANTOR LECTURES ON MECHANICAL ROAD CARRIAGES.

Mr. W. WORBY BEAUMONT'S Cantor Lectures on "Mechanical Road Carriages" have been reprinted from the *Journal*, and the pamphlet (price one shilling) can be obtained on application to the Secretary, Society of Arts, John-street, Adelphi, London, W.C. A full list of the Cantor Lectures, which have been published separately, and are still on sale, can be obtained on application to the Secretary.

Proceedings of the Society.

SIXTH ORDINARY MEETING.

Wednesday, January 20, 1904; DR. YORKE TROTTER in the chair.

The following candidates were proposed for election as members of the Society:—

Allen, Greensill, Rating and Estate Office, London, Brighton, and South Coast Railway, London-bridge Terminus, S.E.

Barrow, Henry Wynford, Ashmore, Upper Redlands-road, Reading.

Brookings, Robert Somers, M.A., LL.D., 5125, Lindell-avenue, St. Louis, Missouri, U.S.A.

Budden, Hanbury A., 401, New York Life-building, Montreal, Canada.

Buxey, Framji Dinshaw, Nesbit-road, Mazagon, Bombay, India.

Chee, Lim Soo, Penang, Straits Settlements.
Chinoy, Bapoogi Ardeshir, 16, Kalboadevi-road, Bombay, India.
Chuan, Lim Kek, Penang, Straits Settlements.
Cox, Major Percy Zachariah, C.I.E., Naval and Military Club, Piccadilly, W., and British Consulate, Muscat.
Deane, Reginald, A.I.N.A., Irish Lights Office, D'Olier-street, Dublin.
De Cosson, Claude Augustin, Public Works Department, Cairo, Egypt.
Dick, Alexander Frederick Henry, 41, Lee-road, Blackheath, S.E.
Eve, George William, 18, Kensington-court-place, W.
Faraday, Charles Arthur, 149, Stapleton Hall-road, Stroud-green, N.
Ffinch, K. H. Maule, Messrs. Tomlinson and Tian Fook, 1, Raffles-place, Singapore, Straits Settlements.
Fook, Chye Tian, Messrs. Tomlinson and Tian Fook, 1, Raffles-place, Singapore, Straits Settlements.
Hong, Lim Eow, Penang, Straits Settlements.
Ikin, Benjamin R., Alsager, St. Fillans-road, Catford, S.E.
Lal, Hon. Munshi Madho, Benares, India.
McEwan, John, Carisbrooke, Enfield, Middlesex.
Mody, Hormasjee N., Great Central Hotel, Marylebone-road, N.W.
Mosbaugh, Francis R., The Huntsville and Bracebridge Tanning Company, Limited, Huntsville, Ontario, Canada.
Rosendale, Otto M., Oregonian-building, Portland, Oregon, U.S.A.
Scanlen, Arthur Dennison, Salisbury, Rhodesia, South Africa.
Scott, Hugh J., Box 204, Middleburg, Transvaal, South Africa.
Shaw, Percy A., care of Messrs. Millers, Limited, Sekondi, Gold Coast Colony, West Africa.
Thompson, Oscar S., 7, Billiter-square, E.C.

The following candidates were balloted for and duly elected members of the Society:—

Chandler, Lincoln, Abbotsfield, Kenilworth.
Cooper, John Ashley, F.S.I., Surveyor's Office, Cooper's-hill, Castries, St. Lucia, British West Indies.
Gilfillan, Samuel, 7, Hampstead-hill-gardens, N.W., and 2, Billiter-avenue, E.C.
Loram, Albert Edmund, F.S.A.A., P.O. Box 105, Pietermaritzburg, Natal, South Africa.
Short, Thomas S., M.I.N.A., 3, Gray-road, Sunderland.
Tenison, Arthur Heron Ryan, F.R.I.B.A., 12, Little College-street, Westminster, S.W., and 19, Bath-road, Bedford-park, Chiswick, W.

The paper read was—

ORGAN DESIGN.

By Thomas Casson.

The special object of my paper is to point out the grave loss in both artistic results and in cost of room and money involved in the prevalent desertion of the ancient canons of organ design for unsystematic and sporadic idiosyncrasies. There is, of course, no reason to be pedantic in matters of taste; but I venture to define taste as the æsthetic conscience. That, like one's conscience in ethics, must be trained and ordinate. So complete is the desertion from old methods, that I, who am more particular than any other English builder to adhere to these ancient and orthodox canons, find myself, by the action of the whirligig of time, actually regarded as a "crank," a "faddist," a setter-forth of "newfangled ideas," and so on.

For instance, I met a few months ago an eminent organist whom I had often invited to see my work; I again asked him, and got the reply: "I am getting old, and we old people like to 'do things in the old-fashioned way.'" Such men will not hear plain truths; but what he regarded as "old-fashioned," was only modern makeshift of the last half of the 19th century, as embodied in the "regulations" of the Royal College of Organists in 1882, already considered obsolete by some.

In 1883 I published a pamphlet, the result of many years' work, dedicated to my friend, the late W. T. Best, who had recognised the orthodoxy of my views. He endeavoured to induce some of the more prominent organ-builders to adopt them; but so far from doing so, there were those who would send my pamphlet to the late Dr. Hopkins, *primus inter pares* in organ matters, as a supreme joke, the latest funny thing. Much amusement was indeed afforded to the venerable doctor, but in precisely the contrary manner to that which had been intended. Even now a builder, who has recently copied my methods, and states, after the usual manner of plagiarism, that he has invented them himself, remarks apologetically that he has done so "by departing from the accepted canons" of the art!

Thus one finds that, with a few artistic exceptions, the normal organ-builder makes no theoretical study of his art, but follows only the rule-of-thumb substituted by that "practical man" of whom the theorist hears so much. The really "practical man" is he who imposes sound practice on a foundation of sound theory. Thus when I adopt the old theories,

and not only work them out in practice, but carry out their inevitable corollaries, I do some things which may seem strange; but theory, corollary, and practice all go together, and I remain the most practical of men, the very last to whose work such terms as "fads," "new fangled," and so forth, are applicable.

To plunge *in medias res*. By far the most fatal divergence from orthodoxy occurred about the middle of the 19th century, when the German organ compass obtained general vogue, unfortunately without the adoption in England of the principles upon which that compass was founded.

For the sake of those who have not studied the matter, I must explain the peculiar difficulties involved in playing keyed instruments of tone sustained by wind, as contrasted with those in which the sound is produced by string-plucking or string-percussion.

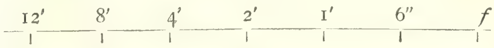
To obtain on the harp or pianoforte a full chord, one may strike a series of notes in *arpeggio*, or chords in succession, leaving the strings free to vibrate. Thus it is possible to have a chord resounding which covers the whole compass of the instrument. Not only so; but by striking notes with greater or less force one obtains accents and expression, and the power to make any particular note or notes stand out from the remainder in song fashion, albeit the tones are marvellously evanescent.

In the organ and kindred instruments the sound commences with the striking of a note, and is maintained with even force until the key is released, when it ceases absolutely. No chord is possible beyond what lies under the hands, there is no true *arpeggio*, nor can accent or expression be obtained by striking the key with greater or less force, nor can a part or parts be thus made to stand out in song. "The removal of the pipe from the living breath of the player is like the fall of man" says Dr. Turpin — "a loss complete and irretrievable."

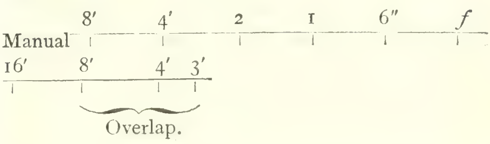
Such drawbacks might seem to put the organ without the pale of musical instruments; but it has its own peculiar and very magnificent beauty, while some ingenious expedients greatly diminish the drawbacks.

In the organ, the sustaining of the harmony involves keeping the hands generally close together; but on the other hand, the organ is singularly ineffective without the characteristic deep tones of the bass, which are thus out of reach of the hands. In England, the deep tones were formerly placed on a long-manual keyboard, that is, one prolonged basswards like that of a pianoforte, a method still prevalent in Italy, where organ-playing is of trivial character. In spite of the skill of many old English masters, and of the prodigious hand-stretch attained by some, these deep bass notes were too far out of reach. Thus the style of playing was either thin from the desertion of the harmony, or destitute of dignity from desertion of the deep notes. Nevertheless, in spite of defective practice, the vital theory was adhered to. The organ was provided with proper basses for all the chief stops. Pray let me especially emphasise this.

In Germany, ideas obtained some hundreds of years before they did in England of full and dignified organ-playing and organ design. The difficulty as to sustaining close harmony by the hands while bringing the deep tones within reach was surmounted by relegating the latter to the feet by means of a wooden keyboard termed a pedal board. The demands of contrapuntal music soon necessitated a pedal board of some two octaves. Thus while in England the ancient compass may be shown by a continuous line from (say) GG of twelve feet, representing the manual only,



the German compass may be represented by a shorter manual keyboard, viz., down to C C of eight feet



supplemented by the pedal-board, which carried the deep tones down half an octave lower than the English organ. This pedal-board had a selection of deep-toned stops termed a "pedal organ," the pipes being of "scale" differing but slightly from that of the manual stops of which they formed the representative basses.

This was efficient and economical, because owing to the smaller capacity of the ear to appreciate tone-character in extreme compass it is found that one pedal stop will furnish a sufficiently appropriate bass for several manual stops; whereas carrying all the manual stops down, as formerly in England, was unnecessary and wasteful. Nevertheless, both German and English methods did recognise that proper basses must be provided for all the chief manual stops. That is the

first and paramount condition as regards the deeper tones.

When in Germany the pedal stops amount to about ten, it is usual to supplement them with a heavy stop, termed a "major bass," for which there is no corresponding treble. This stop is analogous to the drums of the orchestra, and is a powerful and (when used with discretion) an effective reinforcement of the existing basses. A reinforcement, observe, not introduced until the fulfilment of the primary condition, viz., provision of appropriate basses.

The advantage of pedals began to be generally appreciated in England early in the 19th century. At first they were made only to drag down the lower keys of the Great organ. It must not be supposed that even this mild advance was universally welcomed. Organists of position said that "a musician could do with his hands all that could possibly be required;" stoutly affirming that they were "not going to be turned into dancing masters at their time of life," and so forth. Presently heavy large-scaled "pedal pipes" were added to reinforce the existing basses, theoretically just as the Germans had done; but with the most extraordinarily heterogeneous arrangements of compass and relative pitch. Sometimes the pedal pipes would go down to GG of 12 feet, sometimes to GGG of 24 feet, sometimes to CCC of 16 feet, with a "return" in the lowest half octave to pipes of a pitch one octave higher—one shudders at the thought of the inversions—to make it fit the G pedalboard.

Later on the rising appreciation of German organ music, particularly that of Bach, forced into prominence the necessity for adoption of the German compass of manual and pedal keys. The struggle that arose between the advocates of the old long keyboard and those of the shortened keyboard with full compass of pedals—the rivals being known respectively as G men and C men—was of an intensity and bitterness of which the present generation can hardly form an idea. The C men were bound to win, but one has much sympathy with the G men owing to the clumsy way in which the change was effected. In common with the Germans, the G men rightly held that the organ should be provided with proper basses to carry the manual tones downwards and that then, but not until then, were the heavy reinforcing "drum" notes admissible. In defiance of all wholesome musical rule, the English organ-builders lopped off the manual basses at CC of 8 feet and supplied nothing in their place but their existing ponderous drum-toned "pedal pipes"! It was as if one lopped off the orchestra at the lowest note of the violoncello and substituted a big drum for double basses and other deep tones. I have myself too keen a remembrance of the sweet and mellow but sufficient basses of the old long-manual organs not to grieve over the brutal rule-of-thumb which destroyed them without providing any substitutes. The evil method has been but slightly ameliorated. Mr. Best wrote to me in 1887:—

"Unfortunately, when organ-builders shortened the keyboard compass in the region of the 'bass,' they constantly neglected to supply the indispensable equivalent of an adequate pedal-organ. Even in the largest instruments where an attempt is made in this direction, it will be at once remarked that the pedal-bass is suitable only for the 'great' or most powerful clavier; the varieties of delicate tone in the bass (to combine with the more frequently used 'choir' or 'swell' claviers) being almost invariably absent."

It cannot be said that there has been any general improvement in this matter. There is no excuse for this at any rate since 1855, when Dr. Hopkins explained the whole theory in his great work. Bearing in mind that we have both pedals and pedal organ from Germany, where their function has been understood for centuries, he thus writes:—

Par. 1232.—"In Germany most of the pedal stops are properly viewed as simply basses to some of the manual stops. This being the case, their scales exhibit but a very slight advance upon those of the manuals, one pipe only frequently being the extent of the difference."

[This difference of "one pipe," *i.e.* a difference of diameter equivalent to the difference of diameter of two pipes one semitone apart, is a well known device to avoid the defect called "sympathy."]

Par. 934.—"In Germany the 16 feet range is viewed as the most correct one for the organ *stops*, but not for the organ *manuals*. The *pedal* is justly considered as the only proper place for their *bass*. This is conclusively shown in German specifications, where to a Principal of 8 feet on the manual there is a Principal of 16 feet on the pedal; to the 'Octave 4 ft.' on the manual an 'Octave 8 ft.' on the pedal . . . and so on."

Par. 933.—"The advocates for long and short manuals appear to be agreed on one very important point, namely, that the 16 ft. range is the correct one for as many of the organ *stops* as possible; the point of difference being as to where the large pipes should be planted, whether on the manuals or on the pedal."

Par. 1099.—"The Pedal Organ should contain 'bass' to as many of the leading manual stops

possible. The minimum number of pedal stops in Germany is equal to one-third of the number of the Great Organ. The maximum number is one-third of the number of manual stops in the entire organ."

Needless to say, this takes it for granted that the "Great" is the largest division of the organ. Of course, too, the more important the artistic pretensions of the organ the more nearly the pedal stops will approach the maximum.

The musical, or rather unmusical, result of this egregious blunder of noisy but defective pedal organ is frightful. I would ask anyone here whose ear has not been vitiated by long tolerance of the English pedal organ, to listen for this portion of the "music" when next he goes to Church; that is to say, mentally to detach the bass from the remaining parts for comparison with them, and he must be amazed at the effect, and wonder how he or anyone else can have allowed himself to tolerate anything so dull, monotonous, and brutal.

One is met at once by the objection that in room and money the necessary equipment of true pedal basses is too costly. Doubtless in some instances this may be so; but that is a matter with which Art is not concerned. Moreover, one finds that organs unprovided with proper basses can, nevertheless, be furnished with clap-trap and superfluous features, and can be built in such monstrously megalomaniac form as at once to refute this objection of space and money.

It has also been alleged that instead of similarity between trebles and basses, it is more desirable to aim at difference of quality. This is one of those *post hoc ergo propter hoc* arguments that are invariably tainted and suspect, requiring some corroborative evidence to justify them. If the contrast means that when the manual tones are soft, the pedal tones should be loud, or *vice-versâ*, the theory is too ridiculous. If the quality is to differ, we must provide differing basses in sufficient quantity, so that this objection to numerous and varied pedal basses refutes itself. It is not denied that, at the will of the organist, contrast should be obtainable; but the primary requisite is a true bass. There is absolutely no corroborative evidence to the contrary.

I mentioned at the outset that there were two drawbacks to the organ:

1. That notes cannot be made to stand out, in song fashion, from their accompanying harmony.

2. That there is, in the organ, no true expression or accent.

The first difficulty is usually surmounted by having two or more manual keyboards, each acting upon a separate organ. It is thus practicable to play, in one part or more, a characteristic stop on one keyboard while furnishing, by another keyboard and the pedals, a subdued accompaniment.

The difficulty as to accent and expression is to some extent surmounted by the "Swell," a crude device enough, but the only one available. In this the so-called expression, aptly defined by the well-known critic, Mr. Runciman, as a "fake," is obtained by shutting up pipes, usually the whole of one of the separate organs, in a thick wooden box. This box is provided with shutters which may be opened to a greater or less degree on pressing a pedal. Thus, by smothering more or less the tone of the pipes one gets *sforzando*, *crescendo* and *diminuendo* effects. It is no disparagement of its inventor, or of the superb intrinsic effects obtainable by means of it, to express a regret that no true expression is available by such means.

In the old days of thin playing, previously mentioned, the Swell was of very short compass, seldom going below "fiddle" G. It was regarded as a luxury, chiefly for playing solos, with an accompaniment on the "Choir" or soft organ. Gradually, as fuller playing was developed, its value as a choral department was recognised, and there followed the necessity of completing its compass by a proper bass. Bear in mind that the Swell was of English invention and came into use with the long-manual organ, so that the bass, if furnished, would have had to go down to G of 12 ft.

I glance at some expedients to show how the old builders appreciated the musical requirements. Where there were only two manuals the extra low keys of the Swell manual sometimes acted upon the whole "Great" or loud organ, "a very primitive device," as Dr. Hopkins called it. Where there was a third or "Choir" organ, the lower keys of the Swell acted, or the lower harmony was played, on the Choir organ, with much more satisfactory result. As the final device, before the abolition of the long-manual, a few soft stops, though not in the Swell box, were provided to carry down the tones to G G. This, Dr. Hopkins says, was much better than the "primitive device," for the "Choir bass," as it was called, "could be voiced with some regard to the quality and power of the Swell. Still," he says, "this was not quite satisfactory, for of

course the stops could not equally well suit the Swell, whether open or shut." I need quote no more; but I have shown that the old "G men" appreciated the necessity for an appropriate bass for the Swell, down to the bottom compass of the organ.

Now what of the rule-of-thumb "C men" of to-day? They have indeed carried the Swell down on the manual five notes lower than was achieved by the great "long-manual" builder, Green, who, moreover, enclosed all the organ at St. George's, Windsor, in a Swell down to F F F, more than 100 years ago; but for anything lower they are dependent upon the pedal organ. Mr. Best, however, points out that even where an attempt is made to provide basses they are suitable for only the great or most powerful clavier. Thus it will be seen that generally nothing has been done except to adopt on the pedal organ, in aggravated form, the "very primitive device" ridiculed by Dr. Hopkins 45 years ago! That is, as Mr. Best pointed out, to play the Swell bass on stops suitable for the Great organ only. Even if there be some few soft pedal stops, they constitute only the old "Choir bass" described by Dr. Hopkins as "not entirely satisfactory," a very mild way of putting it.

The position tolerated is as though one should have a string quartette, the executants of which should play with all refinements of expression and phrasing, but that to it should be appended a player instructed not only to bring a double bass of extra size and power, but to rasp it *fortissimo* throughout. No one would tolerate such lunacy in the orchestra; why is it tolerated in the organ? It is generally recognised that the organ should not be treated as an imitation of the orchestra; but it has to be treated by orchestral analogy, and in this matter analogy holds good.

If then the Swell is to be recognised as a choral department, it is a necessity, elementary, logical, irrefragable, that it have its own proper pedal bass enclosed with its other pipes in the Swell box. It is an absolute impossibility on any artistic grounds, to refute this statement.

This was perceived, taken as a matter of course, I imagine, by Walcker, of Ludwigsburg, who put a few pedal stops in the Swell of his organ at Boston, U.S.A., about 1866, and, as mentioned in my pamphlet of 1883, in his organ at Riga, 1884, a considerably larger number. It was evidently his practice in organs of importance. In 1883, I furnished an organ at Denbigh with three such pedal stops, the magnificent result amply justifying the theory, and a proper Swell bass had been been contemplated for Hill's fine Panopticon Organ, (now destroyed), when it stood in St. Paul's Cathedral.

Beyond the objection, largely fallacious, as to room and cost, I have heard only one substantial reason against proper Swell basses, and it is substantial only by reason of the high-standing of the learned objector. He states that it cannot be right to have them because they do not exist in the organs at Westminster Abbey, St. Paul's Cathedral, or the large instrument which he himself plays. Now having heard those organs, and setting aside a mental reservation that this may possibly in itself be a reason for their adoption, we have here only a repetition of the "dancing master" argument. About a century ago not one of these organs had pedals at all, therefore I presume that they ought not to have pedals at all even now. Pedals if wrong then are wrong now.

Another proof of the utter lack of comprehension of the primary function of the pedal organ lies in the makeshift and clumsy expedients adopted for its control. "Registering," that is the adjustment of tonal quantity and quality by means of the stops, is now for the manuals, kaleidoscopic and protean as compared with that of a century ago. People were then content with few changes, and the few pedal basses when they did arrive, were adjustable by hand to suit, so far as they could, the changes of manual tone. That is now impracticable. The pedal organ must not only be provided in stops, but there must also be convenient mechanism whereby it can be made instantaneously to furnish a proper bass for any and every combination of manual stops and couplers. Such a contrivance I produced 20 years ago, and have now brought to perfection. But what of the rule-of-thumb CC men? Their notion has been to make the pedal stops move in conjunction with a few arbitrary combination actions, generally of the Great organ only, thus further perpetuating and aggravating the fundamental error pointed out by Mr. Best, viz., that of treating the pedal organ as primarily concerned to supply a bass to the Great organ only!

There is one method of pedal control still in vogue to be mentioned, as it was, by Mr. Best, only with contempt. That is, to have one or two human assistants to work the pedal stops and couplers for the player. Now registering the whole organ is the performer's work. If

he delegates any part to others, he is playing in a duet or trio. The late Mr. Best, in addition to his unrivalled execution, would never suffer anyone to touch a stop for him, or so much as turn over his music ; but he felt the lack of pedal control, and warmly approved my recognition of this work as of paramount importance, and my method of effecting it. Organ control must begin, not end, at the pedal organ.

Mr. Best wrote to me in 1887 :—

"The old expedient of having an assistant on each side of the player to manipulate the pedal stops and couplers, is very properly exploded at the present day, the reasonable demand being that the maker of the instrument shall provide ample and immediate means of control over every department of the tone."

Unfortunately the "old expedient" still prevails, and seems to satisfy such folk as can detach a chorister or two for the purpose. It is, however, certainly unjust to organists who like to play their organs themselves, that they should be left to struggle with a pedal organ, sometimes a large one, together with its couplers, with no adequate controlling mechanism, or even to fight with mechanism which embarrasses rather than helps.

Further evidence of the neglect of sound theory is afforded by the treatment of the pedal basses when the organ is broken up by the builder into the two or more portions of a so-called "divided" organ, when their basses are distributed in heterogeneous fashion in total disregard of musical requirements. This neglect has caused the divided organ to fall into unmerited disfavour. To avoid this and other defects the organ is "unified," which by some perversion of terms means that the manual divisions are lumped together in one part of a building, say the choir screen, while the pedal basses form an unsightly stack of pipes in transept or triforium. Obviously in a divided organ the various divisions should stand complete with their own basses *in situ*.

It must not be supposed that the development of these improvements has been altogether gratifying. It used to be a supreme pleasure to me to go to an organ recital ; but no one who has touched or heard without prejudice an organ furnished with a full, varied, appropriate and amenable pedal bass, can regard the ordinary English organ otherwise than with the utmost loathing. The realisation of that fact has been, I assure you, a heavy punishment.

It is as certain as anything can be that improved musical taste will demand, in no distant time, that the organ shall, in this matter of the pedal in particular, conform to the elementary laws of musical art, which coincide with those of orthodox organ-building. This will involve readjustment of the main parts, and as room is almost invariably deficient for English organs, it necessarily follows that all the huge and costly organs now built or in building will have to be reconstructed. Surely it were better to abolish rule-of-thumb at once, and comply with artistic and scientific law, than to go on expending money of which it is certain that at least half will be wasted. The matter lies with purchasers. They consult as a rule either organists who, for years have steadily vitiated their ears by tolerance of an inanely brutal pedal-bass, or builders who regard with horror the prospect that they or their staff of men—the larger the staff the worse—shall be "put about with new-fangled ideas." You will no doubt remember that the Pre-Raphaelites were greeted with much the same sort of objections in their return to what is true and natural. Some of you too will doubtless recall the struggles of Berlioz against the Conservatoire.

Time does not permit description of my mechanism for control of the pedal-stops and couplers. It is the result of some thirty years study, and I find it necessary to declare that it is from inception to finish absolutely and entirely my own invention. Outwardly it consists of a stud or tablet, labelled "Pedal," one being furnished for each manual.

On touching the tablet, termed a "Pedal Help," the drawstops of the pedal organ and couplers at once move into the correct bass for the respective manual. It matters not what combination be extant on that manual, whether of stops or couplers, the true bass is at once presented. The manual couplings must be considered; for a bass suitable for (say) the Great Diapasons would be no longer sufficient were the Full Swell coupled to them.

Not only is this done but the "Pedal Help" of a given manual having been touched, the pedal organ will of itself follow all changes of that manual until another Help is touched. Of course if one wants special pedal-stops one goes to the drawstops to get them. The movement of the pedal-stops looks somewhat weird, as though an invisible assistant were working them in accordance with the player's wishes.

I hold strongly that indulgence in destructive criticism is seldom justifiable unless the critic is prepared with practicable improve-

ments. The difficulty of pedal control having been vanquished, I must deal with the drawbacks of room and cost.

You have seen that in orthodox organ-building the pedal-basses are, as mentioned by Dr. Hopkins, of practically the same scale as the corresponding manual stops. Now, if you will glance at the diagram, you will see that of the usual 30 pedal notes for each stop, no less than 18 are repetitions of pipes of the same pitch by the overlapping of the upper 18 of the pedal range with the lower 18 of the manual compass; true, the pipes actually required at the bottom of the pedal compass are the largest and most costly, but a great saving, absolutely orthodox, is possible by using this overlapping set of 18 pipes in double capacity for many stops, by applying in this new fashion the old mechanical detail known as "borrowing." I invented and applied this method successfully 22 years ago.

I observe, however, that in his "Story of the Organ," just published, Mr. Abdy Williams states that this contrivance was in use in the 16th century. If I am a little sceptical as to this it is only in the literal and courteous meaning of the term, and because one of the illustrations is not conclusive. Be this as it may, however, the maintenance of a principle is of far greater importance than the question as to who was first the inventor; while as to myself, I shall be only too delighted to find that in one more particular I have followed the cunning craftsmen whom I extol.

Again, a well-designed organ has necessarily a variety of 16 ft. manual stops of quieter intonation and scale than the 8 ft. A "sixteen foot" stop, it may be necessary to state, is one which on the lowest key gives a sound of the same pitch as an open pipe of 16 ft. length, the whole stop sounding an octave below the unison or 8 ft. pitch. Now 16 ft. manual stops are seldom used except for full combinations, so that in soft combinations they stand idle. Thus, though it is not absolutely legitimate to use them also in 16 ft. pitch on the pedal, and one cannot advocate such use for the principal pedal-stops, it is nevertheless practicable to use them with perfect efficiency as basses for soft combinations. *De minimis non curat lex.* This rule is hardly practicable when there has been followed the illegitimate, relatively ineffective, penny-wise, pound-foolish, English rule-of-thumb, which inserts 16 ft. stops in a subsidiary department while excluding them from the chief department. Thus does cheapness war upon economy. There is, too, for reinforcing pedal-stops, the economical practice, very generally employed, of using the upper range of a distinct pedal-stop of 16 ft. as the lower range of one of 8 ft., or the lower range of a 16 ft. stop as the upper range of one of 32 ft., and so on. With a little care, a powerful varied, and efficient pedal organ may be obtained at surprisingly small cost in room and money, provided that the organ be well designed to begin with, on orthodox lines; but enormous additional economies and resources are obtainable on these lines.

Time does not permit of more than a glance at the orthodox way of building up organ tone by artificial over-tones, not only in octaves, but in fifths, thirds, and so forth, known as "Mutation and Mixture work." I can only refer you to Helmholtz, who has elucidated rather than discovered the reasons. Suffice it that this method is the only one of blending the ground tones and over-tones in one satisfactory clang-tint or timbre. Again whether as a suggestion of nature or as a simple matter of art the musical ear demands below the normal 8 ft. unison tones, the presence of stops of 16 ft. pitch known as "Doubles," for enrichment, particularly of the treble, and to impart a fine solemnity and mystery of effect. Now this work of blending the tone is becoming more and more neglected in England. Necessary "mutation" work is too often omitted, almost invariably in fact in relation to "Doubles," while the "Mixture" work, where used, has come to be regarded as a sort of shrieking apparatus, creating an intolerable din in combination with modern reed-work; so that many organ-designers who have not studied the true office of this splendid feature of the organ, have come to deprecate and even omit it. The tones of varied pitch are, through this omission, not blended in one general mixture, but stand out individually in what is known as "top and bottom." It is also exceptional to find more than one "double" or 16 ft. "flue" or flute-form stop on one manual, so that the 16 ft. tone is neither varied nor properly blended.

It seems almost as if many English organists regard as wasted stops that are of minor value for solo use, however valuable in the ensemble. This is an inartistic a view as it would be to reject from the orchestra the priceless blending tone of the bassoon.

Let me draw your attention to the splendid

and orthodox design of the "Great" organ of Schülze's instrument at Lübeck. You will see that beginning at the "double," not only is there variety, but that there is within the whole scheme a complete double or 16 ft. organ. The doubles themselves have their own double of 32 ft. to fill up the higher range. There is a "Quint," or 12th to the double of 16 ft., an ample range of 8 ft., 4 ft., and higher tones of smaller scale than the 8 ft. range, and finally a double Trumpet, all forming a scheme to blend with 8 ft. or normal organ. I do not dwell further upon the magnificence of the conception, nor for my purpose would the qualities of the individual stops be exactly the same. My object is to show how, having adopted these orthodox lines, the method will conduce to economy.

Having this double organ we may draw its stops, and by playing an octave higher gain in makeshift fashion a secondary stop-group of scale smaller than the normal "Great," well balanced in itself and sufficiently individual to form in this varied *rôle* a veritable separate "organ," of the nature of a Choir organ.

Playing an octave higher is, however, a clumsy method, and it is soon limited in the upward direction. It can be more conveniently done by having an octave action and the small and cheap extra octave of pipes and soundboard (without which the octave action is artistically inadmissible), together with my invention of a stop to silence, on being drawn, the normal or 8 ft. action. In this way the "double organ" can be used in its secondary *rôle* in absolutely complete form, while playing in the ordinary position.

It is, however, better to carry the principie a little further in order not to disturb the original normal group. In order to do this I provide for such stops of the "double organ" as are suitable, a secondary stop-group working in conjunction with the octave action only. This secondary group or "organ" can be switched off and on alternately with the original group. This entirely avoids the confusion which is liable to result from using a single stop-group in two different *rôles*, with a further advantage that both groups may be separately "registered" before and during playing. This method of working the principle I term "octave duplication." I refer to the "Great" organ of Mr. Raeburn Andrew, to show how, by this simple treatment of a given organ, designed upon orthodox lines the tonal resources in variety and in preparational registering may be practically donbled. The couplers which augment a given keyboard, are also duplicated for each division of it. An additional "organ" is gained without any additional stops.

It is worthy of remark that while I am constantly told that "duplication" is "illegitimate," "new-fangled," or what not, my less convenient detail for the same result, viz., using stops in octave pitch, together with my unison silencing stop, is now copied and is obtaining vogue, even with the unwarranted omission of the extra octave. That is to say, the principle is to be considered illegitimate unless the details be imperfect and inconvenient. There is much of that sort of argument in all organ improvement. Probably you are acquainted with the same sort of thing in other matters. Not long ago it was "illegitimate" to use the thumb on the keyboard or the heels in pedalling. It is only quite recently that the Germans have admitted the Swell to be "legitimate."

But a further enormous economy results. The large and costly pipes of 16 ft. pitch are all ready for use as pedal basses for the duplicated groups, as you will perceive on glancing at the third column under the head of Schülze's organ. That is, the pipes carry down the tones an octave lower than the manual and are thus legitimately available in the manner previously described. They are usable also, not so legitimately but quite usefully, as quiet basses for other stops. *De minimis*, I repeat, *non curat lex*. It requires an acute ear, even when its owner has been informed of the device, to detect any deficiency even then.

I have shown how the adoption of orthodox design enormously increases the tonal resources while securing great economy in room and material. It remains to exhibit the most important economy of all, viz., that in the mental and physical exertions of the player. The greater the relief from unnecessary drudging and purely mechanical function the greater the freedom in execution and in the art *par excellence* of organ playing, viz., that of registering.

Now, theoretically, the only artistic registering is that of direct manipulation of the stops and couplers, each stop being the deliberate choice of the performer. In practice this is not perfectly to be attained, particularly with a large organ; but the first thing is to rid the performer of everything so mechanical that mechanism can do the work. In this matter the pedal organ and its couplers are the

greatest offenders, because they absorb in purely mechanical work the little intervals which should be available for eclectic registering of manual departments. It is a physical impossibility to register manual and pedal at one operation. For this reason, viz., to give the performer more liberty for direct handling of the manual stops and couplers, I devoted many years study to the control of the "pedal" and have solved the problem, I am assured, with absolute perfection.

Now it will be admitted that effective registering must be by preparation.

1. The best and simplest method is to have several manual organs, ordinarily one for each keyboard, the stops and augmentative couplers of which may be prepared before playing. By merely passing from one keyboard to another effective changes are made, but they are limited to the number of organs available, usually that of the manual keyboards.

2. An extension of this is the ventil method, by which several stop groups are attachable to one manual, and can be brought on at will, thus extending the method first quoted. The groups having been fixed by the builder, are however not arrangeable in the form required by the organist. This and the simultaneous change of couplers and of pedal organ and couplers, impose a severe task upon body and mind, making the method too clumsy for ordinary mortals, notwithstanding the fine results under the hands of a Best, a Guilmant, or a Kendrick Pyne.

3. A third method is known as adjustable combination action, by which stops are thrown in and out, as previously arranged by the organist, on touching a pedal or piston. They are an immense improvement on the fourth method, but they have the disadvantage of either presenting a vast array of exterior accessories, or else of imposing a severe tax upon the memory.

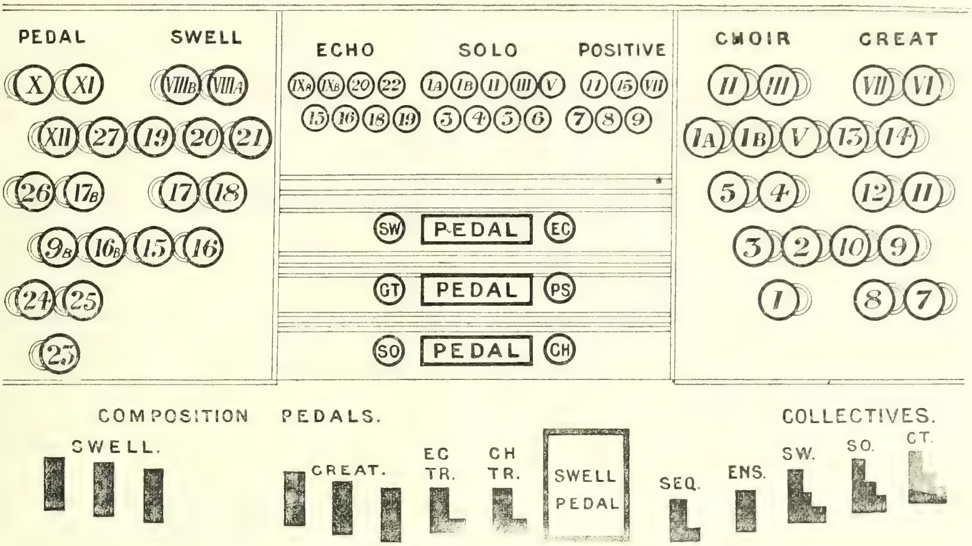
4. A fourth method, useful as a means of rough-hewing eclectic mélanges, but artistically contemptible if regarded as an end, is the "composition" method by pedal or piston. Certain fixed and arbitrary combinations prepared by the builder are exhibited on touching a pedal or piston. Unfortunately the general sacrifice of fine registering to mere rapidity of execution has caused a great number of organists to use this method as an end and not as a means, thereby reducing the glorious colour-palette of the organ stops to a mean species of chromo-lithography.

5. Another method is known as "Collective," by which broad, arbitrary combinations, not displayed by movement of the drawstops, are temporarily effected inside the organ. It is a useful method for occasional use, for the broad contrasts are available without breaking up the prepared combinations, to which one may at once revert. As the combinations are not displayed the method is too difficult and too limited for adoption as the primary system of combination.

Now obviously the first method, if extended, would be the best. It can be extended by having varied stop groups or organs, each having its own augmentative couplers with it, attachable to its own keyboard, to the exclusion of the other groups of that keyboard, on touching a stud or pedal. Each group is made up in accordance with the requirements of the organist. It is clearly displayed, the performer can see which group is in use, the pedal bass is always assured. I show a three-manual scheme of six manual groups or "organs." While playing on the three in use, further preparations can be effected in thoughtful and leisurely fashion in three that are out of action. By this means the manual preparations may be so enormously extended that no stop-moving contrivances are necessary for the manuals of an organ of even considerable size. Every combination is thus the produce of the performer's intellectual and eclectic powers, to the exclusion of all that is arbitrary. In larger organs the fourth or fifth methods may be applied supplementarily, the drawbacks of the third method being hardly necessary.

I give the design of a three-manual organ of 22 manual stops. The weight, dignity and completeness of each primary group allows of the free use of octave couplers, giving immense power. The "duplications," together with the instantly available "pedal," afford in this organ at least double the variety and combinational power of one of equal size as ordinarily built. This organ is of the säme general design as that of Dr. Yorke Trotter, at the London Music School, of which an illustration is given; but the duplicated organ stops are shown above the manuals for clearness of distinction.

You will see at once that taking the normal or ensemble of a given manual, it is possible to arrange its stops and couplers, by duplication for the most part, with separate groups or "organs," in which they can be registered in varied *rôles*. For instance, from the Great organ a second Choir or positive can be formed, prepared before or during performance.



Stops of the choir manual can be similarly treated to form a solo organ. The manual swell can furnish an echo organ and so on. Any group or "organ" is attached to its manual and the other groups of that manual detached on touching its label or piston. That is, the keyboard becomes for the nonce Great, Choir, or Solo. So of the others.

Thus in stop preparation by separate groups or organs, after the method No. 1, this organ is equal to one of six manual keyboards, each complete in itself and in tonal balance. The combinations are always visible, and the tablets show which organs are in action.

It is within the bounds of modesty to state that an organ of given size, built after these methods, has twice the resources of any other of the size; the registering is eclectic brain-work, the pedal-bass musical and perfectly controlled.

That is my claim in the matter of economy, and it is possible only by unreserved adherence to the old orthodox canons of the glorious art of organ-building, as opposed to the imperfect, new-fangled, makeshift, and rule-of-thumb of the latter half of the 19th century.

[Mr. Casson exhibited by way of illustration of his method of "octave duplication," a small organ termed a "Philomel." This is a form of his "Positive" organ. The Great organ has an octave coupler with the necessary octave of pipes, and this is "duplicated" to form a Choir organ on the same key-board. The organ embraces his contrivances for a quasi pedal bass and melody, by means of which the effects of an organ of two manuals and pedals are to a great extent realised by players unused to pedals, or who have to do their own blowing. An important consideration in the case of village and colonial churches, drawing-rooms, &c.

The specification is as follows:—

Great Organ.			*Choir.*	
Contra-Salicional	16 ft.	=	Salicional	8 ft.
Open diapason	8 ft.			
Gedeckt	8 ft.	=	Gedeckt flute	4 ft.
Suabe flute	4 ft.	=	Piccolo	2 ft.
			Voix célestes	8 ft.
Melodic viol	8 ft.	=	Melodic viol	8 ft.
Octave coupler				

Quasi Pedal.

Double bass .. .. 16 ft.

Accessories.

Full organ knee-lever.

All the organ is in a Swell except the Open Diapason.

It is enclosed in a case with burnished front pipes, which is considered preferable to the usual ornamentation.

APPENDIX.

Design for a Concert Organ of Three Manuals.

Lower manual, Choir and Solo.

Middle manual, Great and Positive.

Upper manual, Swell and Echo.

Normal manual stops, 22;	duplicated, 14;	total effective draw stops,	36
,, coupling actions, 12;	,, 7;	,, ,,	19
,, pedal stops, 5;	borrowed, 3;	,, ,,	8
			63

Mem.—The possible coupling effects are upwards of 100.

Lower Manual.

Solo Organ in swell (except No. 6), with extra octave.			Choir Organ, partly by octave duplication.		
1.			Violes d'orchestre	8 feet	61 pipes
2.			Voix célestes, gam. G.	8 ,,	54 ,,
3. Concert flute, ten. C	16 feet	61 pipes	Concert flute	8 ,,	
4. Harmonic flute	8 ,,	73 ,,	Harmonic flute	4 ,,	
5. Saxophone, ten. C.	16 ,,	61 ,,	Corno di bassetto	8 ,,	
6. Harmonic trumpet	8 ,,	73 ,,			
IA. Octave coupler.					
IB. ,, action alone.					
II. Middle manual			Middle manual.		
III. Upper ,, ...			Upper ,,		
IVA.			Sub-octave coupler } Normal 8 feet unison,		
IVB.			,, alone } see note *		
V. Melody			Melody.		
Collective full organ pedal			Tremulant (by pedal).		
Manual help, to attach Solo and detach Choir			Manual help, to attach Choir and detach Solo.		

Middle Manual.

Great Organ, with extra octave.			Positive, or Great Choir, Organ.	
7. Quintatön, ten. C.	32 feet	61 pipes	Quintatön (through)	16 feet
8 { Salicional, ten. C., bass from No. 9 .. .. }	16 ,,	61 ,,	Salicional	8 ,,
9. Bourdon	16 ,,	73 ,,	Gedeckt	8 ,,
10. Open diapason	8 ,,	73 ,,		
11. Waldflöte	8 ,,	73 ,,	Waldflöte	4 ,,
12. Principal	4 ,,	73 ,,		
13. Flauto traverso	4 ,,	73 ,,	Flautino	2 ,,
14. Mixture	V rks. 365 ,,			
VI. Octave coupler.				
VII. Upper manual			Upper manual.	
Full organ pedal.				
Three composition pedals.				
Manual help, to attach Great and detach Positive.			Manual help, to attach Positive and detach Great.	

* *Note.*—Although the sub-octave coupler is not legitimately admissible as a choral accessory it is capable of useful work in quasi-orchestral effects. It would be absurd to exclude it from such purposes where its mechanism already exists.

Upper Manual.

Swell Organ, with extra octave.			Echo Organ, by duplication, except 22.		
15 { Keraulophon, ten. C., bass from 16 .. .. }	16 feet	61 pipes	Keraulophon	8 feet	
16. Suabe flute, st. bass	16 ,,	73 ,,	Suabe flute	8 ,,	
17. Geigen principal	8 ,,	78 ,,			
18. Rohrflöte	8 ,,	73 ,,	Rohrflöte	4 ,,	
19. Harmonic flute	4 ,,	73 ,,	Piccolo	2 ,,	
20. Double hautboy	16 ,,	73 ,,	Hautboy	8 ,,	
21. Cornopean	8 ,,	73 ,,			
22.			Vox humana	8 ,,	61 pipes
VIIIA. Octave coupler.					
VIIIB. Octave action alone.					
IXA.			Sub-octave coupler }	Normal 8 feet unison,	
IXB.			,, alone }	see note *	
Collective full organ pedal.					
Three composition pedals.			Tremulant.		
Manual help, to attach Swell and detach Echo.			Manual help, to attach Echo and detach Swell.		

Pedal Organ.

23. Stopped violone	(18 notes from No. 25)..	32 feet	12 pipes
24. Open diapason	(18 ,, ,, 10)..	16 ,,	12 ,,
25. Swell violone (in box)	(18 ,, ,, 17)..	16 ,,	12 ,,
9B. Sub-bass (from No. 9)..		16 ,,	
16B. Echo Sub-bass (from No. 16)		16 ,,	
26. Flute (open wood)		8 ,,	30 ,,
17B. Swell violoncello (from No. 17)		8 ,,	
27. Trombone (18 notes from No. 6)		16 ,,	12 ,,
X. Upper manual,			
XI. Middle ,,			
XII. Lower ,,			
Three pedal helps.			

General Accessories.

(These are few; because the others are systematically grouped with the divisions to which they belong).

1. Ensemble pedal, on momentarily depressing which the manual helps of the three chief departments are touched.

2. Pedal Sequence, a pedal on hitching which the pedal stops and couplers automatically follow the anges of any manual the pedal help of which has been touched.

3. Compound swell pedal, by which the shutters of the lower and upper manual swells can be worked ndependently by one foot.

"GREAT" ORGAN OF THE MARIEN-KIRCHE, LÜBECK; BY J. F. SCHÜLZE.			"GREAT" ORGAN OF MR. RAEBURN ANDREW'S CHAMBER ORGAN, BY THE POSITIVE ORGAN COMPANY, LIMITED.		
Normal Organ.	Possible use of the "Double" Organ by Duplication.	Legitimate Pedal Basses for the "Double" Organ by Borrowing.	Normal Organ, with extra Octave.	Choir Organ, by Duplication.	Contribution to Pedal Organ.
feet.	feet.	feet.	feet.	feet.	
1. Bourdon, tenor C .. 32	Bourdon, through .. 16	..	1. Quintatön, fld. g .. 32	Quintatön, gam. G .. 16	
2. Double diapason .. 16	Open diapason .. 8	Open diapason .. 16	2. Double dulciana .. 16 (tenor C, bass from 3)	Dulciana 8	{ 18 notes of 32 feet stop.
3. Contra viola 16	Viol di gamba .. 8	Violone 16	3. Bourdon 16	Gedeckt 8	{ 30 ,, 16 ,,
4. Bourdon 16	Stopped diapason .. 8	Sub-bass 16			
5. Open diapason .. 8	..	..	4. Open diapason .. 8		18 ,, 16 ,,
6. Gemshorn 8	Gemshorn 4	Gemshorn 8	5. Salicional 8	Salicet 4	
7. Hohlflöte 8	..	Flute 8	6. Clarabella 8	Claribel flute 4	
8. Viola di Gamba .. 8	..	Violoncello 8			
9. Stopped diapason .. 8	Stopped Flute .. 4	..			
10. Quint .. .. .. $5\frac{1}{3}$	Twelfth .. .. .. $2\frac{2}{3}$	Twelfth .. .. .. $5\frac{1}{3}$			
11. Principal 4	..	..	7. Principal (soft) .. 4	Fifteenth 2	
12. Spitzflöte 4	Spitzflöte 2	Spitzflöte .. . 4			
13. Gambette 4					
14. Twelfth .. .. .. $2\frac{2}{3}$ }					
15. Quint mixture II rks. }			8. Quint mixture .. II rks.	Furniture .. .. II rks.	
16. Mixture .. .. V ,, }	Sundry ranks as available.	Sundry ranks as available.	9. Full ,, .. III ,,		
17. Cymbal .. .. III ,, }			10. Tierce ,, .. IV ,,		
18. Cornet .. .. IV ,, }					
19. Double trumpet .. 16	Trumpet 8	Trombone 16	I. Middle Manual (to Great).	Middle Manual (to Choir).	
20. Trumpet 8			II. Upper Manual (to Great).	Upper Manual (to Choir).	Great to Pedal serves also
21. Clarion 4			III. Octave Coupler.		as Choir to Pedal.

DISCUSSION.

The CHAIRMAN, in inviting a discussion, said that the paper had been an instructive one. For the purpose of discussion they could divide the paper into two parts and look at the subject both from the mechanical point of view and from the artistic point of view. On the mechanical side of organ building he would class such matters as the position of the stops, the position of the swell pedal, the pedal board itself, and the dimensions of the pedal board. He thought that they would all wish that they could obtain something like uniformity from the organ builders in those respects. The most important thing was that all pedal boards should be the same. As to the regulations of the College of Organists they were made some years ago, and a great deal of water had gone under London-bridge since that time, and organ technique had improved very considerably. The time had almost come, he thought, when they might ask organ builders to agree upon some system which would give uniformity. As to stop control and registering, it was quite obvious to his mind that any system which allowed an organist to choose his own combination of stops must be far better than a system which gave only a fixed and stereotyped combination. With regard to the artistic side of organ building, Mr. Casson had laid great emphasis, and rightly so, on the necessity of having appropriate pedal stops for the main division of the organ. In the case of the orchestra, one of the faults of the modern orchestra was that it was not possible in every case to have a good 16 feet tone to every division. The double basses gave an admirable 16 feet tone to the string department. The bass tuba was a very fine instrument, but it did not give an absolutely appropriate bass to the brass. There was no good 16 foot bass for the wood wind. The same applied to the organ. There ought to be appropriate 16 feet basses for the main divisions. They had heard too often, and they heard even now, in the common kind of organs met with in the country, one pedal stop only, with six stops on the great and six stops on the swell. This was of no earthly good to the full organ and, on the other hand, it was far too loud for a soft swell. What they desired was to have appropriate pedal basses to all the main departments. Mr. Casson provided appropriate pedal basses partly by borrowing. Some people objected to that system, and one had heard of the proverb "He who goes borrowing comes sorrowing." But if they granted that there ought to be an appropriate bass for every division, how were they going to get it? Mr. Casson had referred to his pedal help by which he brought on an appropriate pedal to any combination of stops which could be held by the manuals. He (the Chairman) had that pedal help on the organ which Mr. Casson had built for him, and it was a most beautiful invention. It was a very useful thing indeed, and he did not know anything better of its kind. As to the question of expression on the organ he quite agreed with Mr. Casson that the swell pedal did not give proper expression. The only way to get expression was by phrasing or pausing on a note slightly. That, he thought, was the only real expression which existed. He was not quite prepared to admit that there was no arpeggio on the organ.

Mr. MARTIN WHITE said that he believed that about fourteen years ago Mr. Casson built the finest organ for him on the principle which he had been describing. At that time the mechanism was not quite perfected, and it went off after a time. He was glad to know that Mr. Casson had persevered, and had produced organs which worked the system so splendidly. He agreed with Mr. Casson about putting 16 feet stops all through, also that duplication was a splendid system. What he would specially urge was that Mr. Casson and those who had made electrical organs had done more for organ building than all the big builders together, because they forced them to think. When he reconstructed his organ he put on electricity with a second touch. Mr. Casson had said that formerly organists used to do all with their hands. He also referred to bringing out melody or strong qualities on the organ. He would urge upon Mr. Casson that he should do something to bring out an organ with a second touch. With the second touch they could get far better effects out of an organ, and he would strongly urge Mr. Casson to do what he could to adapt the second touch system to the duplicating system. Another matter in connection with organ building suggested itself to him a long time ago, and it was that there were miserable organs built throughout the country because the organists who had to do with the specifications knew nothing about organs. Another very bad feature was, that good organists were very badly paid, and they got very high commissions from the organ builders. Two or three years ago he conferred with many people in the musical world, including two or three of the finest organists in the country, to see whether anything could be done in the way of forming an advisory committee to enable authorities throughout the country to do something for the improvement of organ building. He thought that it would be worth while for the Society of Arts to consider whether they could do something in that direction.

Dr. HINTON said that Mr. Casson had given them a very interesting discourse. There were many points which might be discussed, but they were of such an involved character, that they would lead him very far away if he dealt with them. He would content himself with saying that he perfectly agreed with the legitimate duplication and breaking up and dividing of the pedal organ when it was possible. He did so principally for the reason that the pedal organ was used one note at a time in most cases, and it was then desirable to have a

variety of tones on the pedal organ carrying the principal tones on the manual. As to the question of uniformity of pedal scale, he would suggest that organ-builders should be approached and asked to agree to such uniformity. The organ-builder was about the last man to bring it about of himself. He had to do what he was told. Organists must settle the matter. Organ-builders would then be glad to supply what the organists required.

Mr. CASSON, in reply, said that he hardly needed to say that he was in thorough sympathy with Dr. Yorke Trotter as to the necessity of uniformity in the exterior arrangements of the organ, the accessories and so forth, and the way in which the accessories should work. It was absolutely essential that such things should be fixed, and to arrive at reasonable uniformity in these matters was of far greater importance than that any possible theoretical perfection should be sought to satisfy a few individuals. When the regulations of the Royal College of Organists came out, the College made a great initial mistake in omitting first of all to lay down the law as to what the organ itself was to be before settling what the exterior accessories were to be, and how they were to be fixed and controlled. For instance, if the organ was to be taken as it stood—an instrument with, as a rule, only one or two pedal stops—it was perfectly absurd to make elaborate arrangements for the control of the pedal; whereas if there was a proper pedal organ there must be elaborate arrangements for its control. Again, in orthodox building it would be found that the great organ was the largest department, and the swell the next; but they might constantly find a type of organ which, two years ago, he held up in a lecture as an awful example, in which there were, perhaps, six stops in what was called the great, and about sixteen in the swell, and one or two on the pedal. How could anybody arrange the stops and accessories of an organ of that sort in the same shape as an organ built on proper and orthodox lines and proportions? The thing could not be done. Let the College of Organists be called upon to lay down laws as to the proportion and development of the various departments of the organ, and having done that to set to work on the regulations. At the time that the regulations appeared, he took exception to them and published his protest, but he was then not a very well known man, and it was excusable for the College to ignore him. He thanked Mr. Martin White for his appreciative remarks with regard to his (Mr. Casson's) work. The main point of which Mr. Martin White spoke was double touch. In the arrangement which he (Mr. Casson) had described, he had provided a substitute for double touch. He quite admitted that it was not as perfect as double touch, but it had the advantage that any organist might set to work and use it freely without any preliminary trouble. It might be that some organists would give themselves the trouble to learn double touch; but considering the tremendous mental and physical effort which an elaborate performance on the organ involved, he thought that it would be a long time before organists could adopt double touch. That feature would require a special amount of attention, in addition to the vast amount of work which they already had to do. Double touch had been before the public for a very long time, but it was not a very great success in the organ in which it was first introduced. It was introduced next in the very splendid organ built by Mr. Wedlake for Mr. Hankey, the banker, and the double touch was effected by pneumatic action. That organ was unfortunately burnt about fifteen years ago. Then double touch was brought forward in an electrical form, and patented in that form in 1881 by Schmoele. But although it had been before the public for a considerable time, it had not secured support. Of course it might do so yet, and if there was any desire for it of course it would be easy to produce it in either an electrical or a pneumatic form, although he (Mr. Casson) would not attempt it in a mechanical form. What he had said in allusion to the remarks of the Chairman would, he thought, answer those of Dr. Hinton. With regard to the general adoption of a more uniform method, he believed that it would be by no means difficult to arrive at a general comprehensive plan subject to laying down, first of all, a rule as to what an organ should be. He wished to draw attention to the general arrangements of a console such as was represented in the illustration attached to the paper. This was an organ at the London Musical School. It would be seen that the pedal bass organ was to the left of the player. There was a very remarkable addition to that organ. Of course the primary duty of the pedal organ was to provide a bass; but there was a second object, and that was to provide distinct and differing obbligato and solo basses. Above the keyboard would be seen a small group of pedal stops. [Mr. Casson further described the arrangement by means of a diagram, and illustrated his remarks at intervals by demonstrations on a chamber organ which had been set up on the daïs for the occasion.]

The thanks of the meeting were unanimously accorded to the reader of the paper.

Miscellaneous.

VICTORIA AND ALBERT MUSEUM.

Several additions of interest have recently been made to the Art Collections in the Victoria and Albert Museum. Two plaster casts have been added to the Historical Collection of Reproductions in Plaster from the Antique. The first is a copy of the marble figure known as the "Apollo delle Terme": this figure was taken from the Tiber at Rome in 1891

and is now in the Museo delle Terme; it is considered to be a Græco-Roman copy of a work of the Pheidian period. The second cast represents a kneeling youth, the head, unfortunately, missing; the marble original of this exquisite statue was found at Subiaco in 1883 and is now preserved in the same museum: it is Attic work of the second half of the 4th century B.C.

For the section of furniture and woodwork three specimens of wood-carving in oak from the district of the Rhine have just been acquired. The Museum has hitherto had but very few representatives of this type of art.

To the generosity of Mr. J. H. Fitzhenry is due the addition of a series of tiles of the greatest interest to the collection of French faïence; they are stated to date from the 14th century, and come from St. Julien de Brionde (Haute-Loire). On an enamel surface is painted Gothic leaf-work encircling shields of arms. The same gentleman has given a small collection of French encaustic tiles decorated with figures quaintly drawn and shields of arms. Five of them date from the 14th century and the sixth is of the 16th century.

In the Persian Ceramic Court of the Cross Gallery may be seen a large glazed earthenware vase, admirably painted with mythical lions and birds in the Chinese style. This very fine example was probably painted by the Chinese at Ispahan at the Court of Shah Abbas II. in the early years of the 17th century, and has been presented to the Museum by C. M. Marling, Esq., now British agent at Sofia.

A re-arrangement of the pewter-work in the Museum has just been made and the opportunity has been taken of separating the English specimens from the foreign. Certain additions to this section may also be noticed, among them being a pair of "pricket" candlesticks from Dorcheim Church in Hesse-Nassau, and a large dish and plate, both bearing the arms of the Company of Cordwainers of London, by whom they were presented to the Museum.

In this same Court should be noticed a very important addition to the Museum collection of chalices: it is an English silver parcel-gilt chalice and paten of the pre-Reformation time, with London hall-mark for the year 1527-8. The engraving is rude and the chalice has been repaired from time to time.

In the gallery near Lord Leighton's cartoon, "The Arts of Peace," a selection of drawings lately acquired for the National Art Library, is now exhibited for the first time. These include two original drawings for illustrations in the Moxon edition of Tennyson's poems, by Sir J. E. Millais, P.R.A.; one for Dickens's "Little Dorrit," by James Mahoney; one for "Once a Week," by F. W. Lawson; and one, "Mrs. Bardell in Mr. Pickwick's arms," by "Phiz" (H. K. Browne) for the "Pickwick Papers." Frank Barnard is represented by a tinted study of "Alfred Jingle." Specimens are also shewn of drawings made for *Punch*, by John Leech (pencil studies, each with a proof from the finished wood block); Charles Keene (pen drawings); and George du Maurier (pencil studies from the artistic sketch-book, pen drawings, and proofs from the wood-blocks). On the walls of the National Art Library reading-room are also displayed a set of original drawings, and tinted and working proofs of Randolph Caldecott's picture-books and *Graphic* illustrations.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock:—

JANUARY 27.—"Ice Breakers and their Services." By ARTHUR GULSTON. DR. FRANCIS ELGAR, F.R.S., will preside.

FEBRUARY 3.—"Steam Cars for Public Service." By THOMAS CLARKSON, M.I.Mech.E. LIEUT.-COL. H. C. L. HOLDEN, R.A., F.R.S., will preside.

FEBRUARY 10.—"Thermit." By CHARLES VERNON BOYS, F.R.S.

FEBRUARY 17.—"Garden Cities in their relation to Industries and Agriculture." By A. R. SENNETT.

FEBRUARY 24.—"Mahogany and other Fancy Woods available for Constructive and Decorative Purposes." By FRANK TIFFANY.

Dates to be hereafter announced:—

"Lessons to be Learnt from the Fire Brigade Appliances at the late International Fire Exhibition." By EDWIN O. SACHS.

"Artificial and other Building Stones." By L. P. FORD.

"Early Painting in Miniature." By RICHARD R. HOLMES, C.V.O.

"Mechanical Piano Players." By J. W. COWARD.

"Agricultural Education." By J. C. MEDD.

"Motor Cars for popular use." By MERVYN O'GORMAN, M.Inst.E.E.

"Physical Degeneration." By ROBERT JONES, M.D., B.Sc., F.R.C.S.

"The Rural Housing Question." By F. BRICE PHILLIPS.

INDIAN SECTION.

Thursday Afternoons, at 4.30 o'clock:—

FEBRUARY 11.—"Our Commercial Relations with Afghanistan." By COLONEL SIR THOMAS HUNGERFORD HOLDICH, R.E., K.C.M.G., K.C.I.E., C.B., Member of Council. The Right Hon. SIR J. WEST RIDGEWAY, G.C.M.G., K.C.B., K.C.I.E., will preside.

MARCH 10.—"China Grass: its Past, Present, and Future." By FRANK BIRDWOOD, B.A. PROF. SIR WILLIAM RAMSAY, LL.D., F.R.S., will preside.

APRIL 28.—"Industrial Activity in Calcutta." By FREDERICK GROVER, A.M.Inst.C.E., M.I.M.E.

MAY 12.—"British-Grown Tea." By A. G. STANTON.

COLONIAL SECTION.

Tuesday afternoons, at 4.30 o'clock :—

FEBRUARY 9.—The Biology of Federation." By the Hon. SIR JOHN ALEXANDER COCKBURN, K.C.M.G.

[Members will please note that the date of this meeting has been changed from the 2nd to the 9th of February.]

MARCH 1.—"Nigeria." By LADY LUGARD (Miss Flora L. Shaw). The DUKE OF MARLBOROUGH, K.G., Under-Secretary of State for the Colonies, will preside.

MARCH 22.—"Cotton Growing in the British Empire." By ALFRED EMMOTT, M.P.

APRIL 12.—"The Regeneration of South Africa." By BEN. H. MORGAN.

MAY 3.—"Canada and Great Britain." By W. L. GRIFFITH.

APPLIED ART SECTION.

Tuesdays, at 4.30 or 8 o'clock :—

FEBRUARY 16.—

MARCH 15, 4.30 p.m.—"Recent Developments in Devonshire Lace-making." By ALAN S. COLE, C.B

APRIL 19.—"The Sentiment of Decoration." By ALFRED EAST, A.R.A.

CANTOR LECTURES.

Monday evenings, at 8 o'clock :—

J. LEWKOWITSCH, PhD., M.A., F.I.C., "Oils and Fats—their Uses and Applications." Four Lectures.

LECTURE I.—JANUARY 25.—Extent of the Oil and Fat Industries—Sources of Supply—Raw Materials—Modern Methods of Manufacture.

LECTURE II.—FEBRUARY 1.—Methods of Refining — Bleaching — Demargarinating Processes—The Industry of Edible Oils and Fats—Butter Substitutes —Lard Substitutes—Chocolate Fats.

LECTURE III.—FEBRUARY 8.—Burning Oils—Paint Oils—Lubricating Oils—Blown Oils—Boiled Oils—Varnish Industry—Linoleum Industry—Vulcanised Oils—Turkey red Oils—Modern Theory of Hydrolysis of Fats.

LECTURE IV.—FEBRUARY 15.—Modern Processes of Saponification—Candle Industry—Soap Industry —Manufacture of Glycerine—Recovery of Glycerine from Soap Lyes.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, JAN. 25...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Dr. J. Lewkowitsch, "Oils and Fats—their Uses and Applications." (Lecture I.)

Surveyors, 12, Great George-street, S.W., 8 p.m. Mr. Ralph Neville, "The Garden City Scheme and First Garden City, Limited."

Geographical, University of London, Burlington-gardens, W., 8½ p.m.

Actuaries, Staples-inn Hall, Holborn, 5 p.m.

Camera Club, Charing-cross-road, W.C , 8½ p.m. Dr. G. H. Rodman, "The Photography of some Electrical Phenomena."

Medical, 11, Chandos-street, W., 8½ p.m.

Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p.m. Dr. Walter Aubrey Kidd, "Two Paths, One Goal," being an Examination of Archbishop Temple's Bampton Lecture for 1884.

London Institution, Finsbury-circus, E.C., 5 p.m. Prof. G. B. Howes, "The Crustacean Question."

TUESDAY, JAN. 26 ..Royal Institution, Albemarle-street, W., 5 p.m. Prof. L. C. Miall, "The Development of Animals." (Lecture III.)

Medical and Chirurgical, 20, Hanover-square, W., 8½ p.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Mr. Alfred Edward Carey, "The Sanding-up of Tidal Harbours."

Anthropological, 3, Hanover-square, W., 8½ p.m. Annual Meeting.

WEDNESDAY, JAN. 27...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. Arthur Gulston, "Ice-breakers and their Services."

United Service Institution, Whitehall, S.W., 3 p.m. Major-General Sir E. H. Collen, "The Administration and Organisation of the Army in India."

Royal Society of Literature, 20, Hanover-square, W., 8½ p.m.

British Astronomical, Sion College, Victoria-embankment, E.C., 5 p.m.

THURSDAY, JAN. 28...Tramways and Light Railways Association (at the HOUSE OF THE SOCIETY OF ARTS), John-street, Adelphi, W.C., 8 p.m.

Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

National Indian Association, Jehanghir Hall, Imperial Institute-road, S.W., 4½ p.m. Miss E. Hughes, "The Education of Women in the Far East."

London Institution, Finsbury-circus, E.C., 6 p.m. Mr. H. T. Ashby, "A Pilgrimage to Classic Shrines in Greece, Asia Minor, and Crete."

Royal Institution, Albemarle-street, W., 5 p.m. Mr. G. R. M. Murray, "The Flora of the Ocean." (Lecture III.)

Electrical Engineers, 25, Great George-street, S.W., 8 p.m. 1. Discussion to be opened by Dr. J. A. Fleming on Mr. Hibbert's paper, "The Edison Accumulator for Automobiles." 2. Discussion on Dr. Hans Behn-Eschenburg's paper, "The Magnetic Dispersion in Induction Motors, and its Influence on the Design of these Machines."

Camera Club, Charing-cross-road, W.C., 8½ p.m. Hon. W. L. Allardyce, "Fiji and its Inhabitants."

FRIDAY, JAN. 29...Women Journalists (at the HOUSE OF THE SOCIETY OF ARTS), John-street, Adelphi, W.C., 8½ p.m. Lady Trevelyan, "The Bill to enable Women to be elected and act as Members of County and Borough Councils and Metropolitan Borough Councils."

United Service Institution, Whitehall, S.W., 3 p.m. Sir Charles W. Dilke, "The Report of the War Commission."

Royal Institution, Albemarle-street, W., 9 p.m. Mr. D. Hogarth, "The Marshes of the Nile Delta."

Civil Engineers, 25, Great George-street, S.W., 8 p.m. (Students' Meeting.) Mr. Archibald P. Head, "Metallurgy as applied in Engineering."

Art Workers' Guild, Clifford's-inn Hall, Fleet-street, E.C., 8 p.m.

SATURDAY, JAN. 30...Royal Institution, Albemarle-street, W., 3 p.m. Mr. J. A. Fuller Maitland, "British Folk Song" (with vocal illustrations). (Lecture III.)

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FRIDAY, JANUARY 29, 1904.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

NEXT WEEK.

Monday, February 1, 8 p.m. (Cantor Lecture.) J. Lewkowitsch, Ph.D., M.A., F.C.S., "Oils and Fats—their Uses and Applications." (Lecture II.)

Wednesday, February 3, 8 p.m. (Ordinary Meeting.) T. Clarkson, M.I.Mech.E., "Steam Cars for Public Service."

Further details of the Society's meetings will be found at the end of this number.

CANTOR LECTURES.

On Monday evening, 25th inst., Dr. J. Lewkowitsch delivered the first lecture of his course on "Oils and Fats."

The lectures will be published in the *Journal* during the summer recess.

APPLIED ART SECTION.

The Proprietors of the *Graphic* have kindly invited the Applied Art Section to visit their new printing offices in Tallis-street, Victoria-embankment, E.C., on Thursday evening, February 18, from 8 to 10.30 p.m., when the various processes in the production of an illustrated paper will be shown in operation.

As the accommodation is limited, not more than 100 cards of invitation will be issued. These cards will be issued in order of application to members until the number is exhausted. Any member who desires a ticket should apply at once.

Each ticket will admit the bearer and one friend.

No one can be admitted without a ticket.

Proceedings of the Society.

INDIAN SECTION.

Thursday afternoon, January 14, 1904; The Right Hon. St. John Brodrick, M.P., Secretary of State for India, in the chair.

The paper read was—

THE PRESIDENCY OF BOMBAY.

By Sir William Lee-Warner.

The Society of Arts has set before itself the task of supplying to its members information regarding each of the provinces into which British India is divided, and, in pursuance of that purpose, has asked me to read a paper to you upon the Western Presidency of Bombay. Past experience has shown that Indian officials who have been honoured with the invitations of the Society have invariably claimed for the province in which they have served a distinguished, and generally the foremost, position in the Indian firmament. The "land of regrets" casts a spell over her servants, and when they leave the scene of their official lives, they usually leave their hearts behind them, and transfer their regrets and longings to the home of their retirement. I am no exception to the rule, and shall not attempt to disguise my preferences for Bombay; but I hope to disarm envy and hostility by confessing that, unlike the usual traveller to the East, I possess no such intimate knowledge of the claims of other provinces as would justify me in denying to each one of them [the second place of honour in the list of Indian Governments. It is only polite to the members of this great Society to assume that they know all about Bombay that is told in encyclopædias or gazetteers, and desire to go beneath the surface of that general knowledge which every school boy of the 20th century is supposed to possess. I shall resist the temptation of dealing with the poetry of life in Bombay, merely inviting attention to Sir George Birdwood's enchanting description of the "Maratha Plough," in the "Asiatic Quarterly Review," for July, 1888. The main object of this paper will, therefore, be to convey to those who may read it a distinct impression of the Western Presidency without entering into unnecessary statistics or details of administration. In particular, stress will be laid upon the

importance to the Indian Empire of its western province, the special difficulties of its government, its past glories, and its prospects for the future.

Area and Population.

Bombay Presidency is a geographical or administrative expression, comprising a long strip of the coast of India, extending for 15 degrees from Baluchistan on the north to the Madras district of Kanara on the south. Its area, 122,984 square miles, with a population of 18,500,000, is divided into four divisions, under Commissioners, known as Sind, the northern division or Gujarat, the central division or the Dekhan, and the southern or Karnatic division. The number of its districts or collectorates, excluding the island of Bombay, is twenty-four. Six in Sind —Karachi, Hyderabad, Sukkur, Larkhana, Thar and Parkar, and the Frontier district; six in the northern division—Ahmedabad, Kaira, Panch Mahals, Broach, Surat (where the seat of the Company's authority was established until 1687), and Thana; six in the central division — Ahmednagar, Khandesh, Nasik, Poona, Satara, and Sholapur; and six in the southern division—Belgaum, Dharwar, Bijapur (known as Kaladgi until 1885), Kanara, Ratnagiri, and Kolaba. The utmost variety of races, tongues, and physical conditions is thus united in the Presidency of Bombay. Sind is the Egypt of India, the land of the Indus, as Egypt is the land of the Nile, a country of desert and infinitesimal rainfall, in which every want of man can be provided by irrigation. An area of 47,066 square miles is peopled by 3,210,913 souls, yielding a revenue of 141 lakhs. The population consists of Rajputs on the east; Baluch tribesmen on the north; and a miscellaneous collection of Pathans, Lohanos, Panjabis, Gujarathis, and Marathas, the inpourings from the neighbouring countries. British capital and Western science have alone made Sind habitable and prosperous. Without the constant application of both of them, the desert would again reclaim its own. There is only one Native State in the division—Khairpur, the remnant of the Talpur dynasty that ruled in Sind before the conquest, a State to which Mir Ali Murad attempted, by forging a leaf in the Koran, to add three districts; but the fraud was discovered in 1848, and the territories annexed. Formerly the political charge of Sind included the huge block of Native States, known as Baluchistan, which Lord Dalhousie brought within the British protectorate by a treaty negotiated at the time of the Crimean War by John Jacob. The transformation of desert, and deserted Sind into a prosperous division, has been almost the work of an enchanter's wand. In 1856 it supported a population of 1,770,000; in 1881, of 2,414,000, and now one of 3,211,000. The pacification of the border tribes by giving them lands to cultivate, and by alternately showing them the sabres of Jacob's Horse and the attentions of British dispensaries is one of the triumphs of Western civilisation, while Karachi, under the hand of the engineer, has grown from a village of no account, to be one of the greatest ports and cities of India. When Lord Dalhousie visited it on the 23rd of January, 1850, he described it, in his Journal, as "an inconsiderable place, built entirely of mud, lying in the bottom of the basin." It is now a port of call for steamer lines, the centre of two railway systems, and the meeting ground of three great trade routes. Very different in its features and history is the northern division of Gujarat. With an area about one-third of Sind, the rich division of 13,710 square miles holds a population larger than that of Sind, 3,513,532 souls, and yields a gross revenue of 128 lakhs. The small district of Kaira has a population of 450 to the square mile, and Surat, one of 314 in the same area. A generally sufficient rainfall which, in the coast districts, is always heavy, ensures a level of prosperity unknown elsewhere. The country is beautifully wooded, the villages large and prosperous; and cotton, sugar-cane, and tobacco are among its varied products. A great number of aboriginal tribes — Bhils, Kolis, and Thakurs—have been civilised and taught to exchange a life of robbery and game-hunting, for the less exciting, and more remunerative labour of agriculture. The more adventurous elements in society, the Bohras and the Parsis, have extended their quest for profits to Africa and the Colonies, Altogether, there is a life and activity in the northern division which distinguishes it from the rest of the Presidency. Numerous patches of foreign territory still cut up the British districts, while the area of Native States is far more considerable than that of the British territory.

The central division is the home of the Maratha Empire, as the Manjha, in the Punjab, was that of the Sikhs. Here the full effect of a precarious rainfall is constantly felt. The district with the highest average of population is Satara, with 238 souls to the square mile, but the largest dis-

trict is Khandesh, with nearly one and a-half millions, and a density of 142 to the square mile. The four other districts, are Poona, Nasik, Ahmednagar, and Satara. Every district is bounded on some side by Native States. There are numerous forts, forests, and rough tracts to harbour offenders, and with constant failure of crops the public tranquillity is not maintained without serious effort. The British area is nearly three times as large as that of the northern division, 37,192 square miles, with a population of nearly six millions, yet the revenue barely exceeds 157 lakhs of rupees. The population is almost entirely agricultural, and mainly Hindu.

The southern division, with an area of 25,000 square miles, and a population of just over five millions, and a revenue of nearly 130 lakhs, defies any general description. The alluvial plains of Sind, watered by its great river, the gardens of the northern division, and the parched plateau of the central division, fairly describe the main features of each of those portions of the Presidency. But the southern division has all the extremes; Bijapur, constantly visited by drought and famine, with 130 souls to the square mile, lies on the plateau above the Ghats; Ratnagiri and Kolaba, with about 290 to the square mile, lie on the coast, and suffer from such an excess of rain that communications are hardly maintained. In them Maratha is the chief vernacular, while in Kanara, with its dense forests, close atmosphere, and heavy rains, and in Dharwar and Belgaum, with their cool climate above the Ghats, Kanarese is the chief tongue.

Native States.

Besides the British territories, thus divided into 24 districts, there are 65,761 square miles of foreign jurisdiction, and a population of nearly seven millions, subjects of some 353 rulers or chiefs, exclusive of Baroda, which is no longer under the political control of the Governor of Bombay. Fortunately, a solid block of 20,882 square miles, with a population of 2,329,196, is divided off in Kathiawar, and the single State of Kutch, with 7,616 square miles, lies apart by itself, But the rest are scattered all over the Presidency, most of them huddled together in the northern division, under the Palanpur, Mahi Kanta, and Rewa Kanta agencies, others scattered about the Dekhan and the Konkan, and one of importance, the State of Kolhapur, 2,855 square miles, blocking the road between Satara and Belgaum. These numerous States are the predominant feature of the Bombay Presidency; and its responsibilities stretch across the sea to Aden and Perim, where 75 square miles, in defiance of geography, are by law a part of Bombay. Not long ago, the Somali coast, on the shores of Africa, was also under the administration of the same Government.

The Importance of Bombay.

Bombay, with its 123,000 of square miles of British territory, stands only fourth in the list of Indian provinces, Burma covering 236,000, Bengal 151,000, and Madras about 142,000, the United Province of Agra and Oudh following close upon its heels with 107,000 square miles. In population it also stands fourth, having about a quarter of that of Bengal, about two-fifths of that of the United Provinces, not one-half of that of Madras, and not quite twice that of Burma. Yet the results of British administration for a century, notwithstanding physical and racial difficulties unequalled in any other province of India, have made it the most educated, progressive, and liberal contributor to the imperial revenues of any province in the Empire. Its urban population is larger in proportion than that of any other province. It can boast of five cities, each counting more than 100,000 inhabitants. Its 165 municipalities and the number of its native members, 2,100, taking part in their administration, are exceeded not even in Bengal with its vastly larger population. The assessed taxes paid in 1901-1902 by the western presidency amounted to 40 lakhs, against 57 in Bengal, 30 in Madras, and 26 in the United Provinces. Until plague dethroned Bombay city it paid more in income tax than Calcutta. If man made the town and reaps the profit of it, the rural population is hardly less generous to the Indian treasury. The land revenue of Bombay was in the same year 441 lakhs, against 408 in popular and favoured Bengal; its irrigation revenue exceeded that of its eastern rival by two lakhs. Its rocky hill sides and unculturable wastes are turned to account, and its forests yield nearly 24 lakhs against 13 in Bengal and 17 in the United Provinces. Taking all the principal heads of revenue for the year ending March 31st, 1902, the Bombay Government, although the Presidency had just emerged from the miseries of plague and famine, collected 1,282 lakhs, against 1,180 from Madras and 948 lakhs from the United Provinces. There is no evidence that the population is crushed by the weight of the

burden it bears. On the contrary, its deposits in the savings banks amount to 284 lakhs, whereas Bengal with its 74 millions saves only a little more, the average balance of each depositor in Bombay being Rs. 173 against Rs. 114 in Bengal. Activity and progress are visible on all sides. The letters and postcards received for delivery in the Presidency proper, excluding Sind, outnumber those received in Madras, Bengal, and the United Provinces, with their denser populations, by ten, fifteen, and thirty-one millions respectively. In the volume of work done in all departments of postal business—newspapers, letters, parcels, and inland money orders—Bombay stands far ahead of every other part of the Empire. In education, thanks to a consistent policy and the guidance of Lord Reay, it is without a rival, not merely as a pioneer in female education, schools for chiefs' sons, and technical instruction, but in quality and quantity of results. The expenditure in this great department exceeds that of the four provinces — the United Provinces, Central Provinces, Berar, and Burma combined. Its institutions educate one-fourth of all the girls and one-seventh of all the boys under instruction in India; and the schools of the Native States, especially in Kolhapur, Kathiawar, and Baroda, formerly under the control of Bombay, have caught the infection of a good example. The foreign commerce of the Presidency bears testimony to the general spirit of enterprise, and the prudence and good management of the Government which made port-trusts a success before the rest of India thought about them. Out of an aggregate of imports by sea, excluding Government stores and treasure, valued at £67,000,000 (calculating the exchange at ten rupees for the pound), in 1901-2, Bombay and Sind took 32, against 25 and 6 millions for Bengal and Madras. Thirty-six million pounds worth of exports, out of a total volume of 88½ millions, went from the Bombay Presidency, against 37 and 8 millions from Bengal and Madras respectively. The vessels built in Bombay and Karachi for that year, whether steam or sailing, numbered 3,868, out of a total of 4,833 built in the Indian Empire. The railway-borne traffic of the Presidency bears similar testimony to local enterprise, and the number of factories, 373 under inspection, far exceeds that of Bengal or any other province.

There are other features which add importance and interest to the Western Presidency. The two great harbours of Bombay and Karachi are the gates from the west that open on India, and so long as the political anxieties of the future are mainly concentrated upon the north-west frontier, the improvement and safety of these ports must be of vital consequence to the Empire. In architecture, of which some illustrations will presently be shown to you, Bombay is full of interest. The Chaitia Buddhist cave at Karli and that at Nasik, dating from 78 B.C. and 129 B.C. respectively, present features not to be found elsewhere, the screen at Karli being specially remarkable. Those at Ajanta, on the frontier of Khandesh, are nearly as interesting as the Ellora caves. The ruins of the Adil Shahi dynasty at Bijapur crowd into a single century from 1557 onwards a marvellous wealth of architectural power. The Titanic size and beautiful proportions of its domes and arches, tombs and palaces, are as striking as the exquisite ornament and rich tracery of their windows and other details. Veritable chips from the workshop of the gods lie all over the sparsely inhabited city of to-day, surrounded by inhospitable plains, which once numbered its inhabitants by hundreds of thousands, and they tell to ears that can hear the tale of departed glory and wasted opportunity. More eloquent are the Indo-Saracenic mosques, tombs, and wells of Ahmedabad, which combine the finish of Chalukian artists with the largeness and unity of conception of the Mohammedans. The window on the walls of the Bhudder, with its arrangement of three trees and four palms, is a gem of art in its design and tracery, as you will presently see. But the point on which I now wish to insist is the tale which the builders of these relics tell of a Mohammedan rule raised upon Hindu foundations, and of conquerors forced by the strong influence of the place and its inhabitants to alter their rigid rules, and become partners with the conquered, even in the solemn duty of expressing in stone their laments for the dead or their devotion to God. Cambay, Dholka, and other places in Gujarat contribute worthy memorials of the past, while in Sind the coloured tiles, with the beauty of the patterns and the harmony of their tints, still remind the people of Tatta of their Persian connection. In short, the stones of the Presidency tell their story of conquerors following conquerors, and leaving behind them confusion and variety. The Flora and the Fauna are also witnesses of man's attempt to join together in one province distinct families of creation.

A History of Confusion.

Until the fall of the Peshwa, after the battle of Kirkee, in 1817, enabled the British to give form and substance to that vague generality known as the suzerainty of the Peshwa, which was then ceded to the victorious Company, no single thread, however slight, had ever united the four divisions of the Presidency. Elsewhere the British Government gathered the harvest of military successes or political achievements accomplished by those who had preceded it, such as Ranjit Singh, Hyder Ali, the Nawabs of Bengal, or Kings of Oudh. Thus the Lion of the Punjab levelled the ground by suppressing all rival States and converting that whole province into one kingdom, so that his successors inherited a well-defined and settled area already united under one rule. In Bombay the case was quite different. There the four heterogenous divisions have been welded together into one province for the first time in history; and, with the exception of Sind, the divisions themselves corresponded to nothing previously known. A very brief account of the past history of each division will serve to bring into strong relief this state of absolute confusion and chaos. Sind had indeed been a province of the Delhi Empire up to 1739, but it had no sort of connection with the Dekhan. When it ceased to be a recognised part of the Moghul Empire and passed into the dominions of Nadir Shah, the Kalloras really ruled over it, to be ousted by their Ministers, the Talpurs, who, in turn, divided it up into States, of which Khairpur is the sole survival. But the province meant little more than the lands which could be watered by the Indus through its natural rise, and the highly-cultivated and populous districts of British Sind, brought under perennial canals, constitute a new country under an old name. Passing on to the northern division, we find a worse state of confusion. When the powerful dynasty, whose noble buildings still adorn Ahmedabad, fell before the expansion of the Empire of Delhi, under Akbar, in 1572, the conquerors never held their own for long, and the boundaries were always shifting. The Rajputs from the north, the Kolis, and other half-civilised races from the east, and finally the Marathas from the south, applied a pressure which the Viceroys could not resist, and adventurers pegged out their claims at Baroda, Junagarh, Balasinore, Cambay, Palampur, and Broach. Of these, the Gaekwar might have proved the most formidable if military talent had only been hereditary, and if the Marathas could only have conceived a higher idea of the duties of Government than that of extorting revenues by force, and neglecting the preservation of order and the administration of justice. The Gaekwars did nothing to make the people respect them, and it was inevitable that the Court at Poona should seek to profit by the acquisition of a family which owed its rise to the Peshwas, and professed allegiance to them. Accordingly Baji Rao, in 1750, compelled Baroda to admit the claim of Poona to half the Chout. The hand of Baroda, in its turn, was stretched out in every direction, laying claim to tribute in Kathiawar, the Mahi, and the Rewa Kantas, and then sending out armed expeditions to collect what it chose to demand from the peasantry, or landowners. Afraid of further demands from the Court at Poona, the Gaekwar entangled himself with the British Company, and when he could not pay his debts, or discharge his treaty obligations, he ceded districts to the Government of Bombay, and thus a territorial foothold was established by the Bombay authorities in Gujarat. The Company, from that time forward, did its best to protect the smaller Native States from the oppressions of the Gaekwar. It ascertained and settled the amount of the tribute due to Baroda, and eventually collected it for its ally, forbidding him to interfere further in the affairs of the chiefs of Kathiawar and Gujarat. For a while the Company stood between the people and their oppressors at Baroda, and between him and his overlord, the Peshwa. At last, with the fall of Peshwa, his share in Gujarat fell to the Company, and an honest attempt was made to respect the possessions of everyone, no matter how they had been acquired, and to insist upon peace. The result was that the British showed in Gujarat a great tenderness for the petty sovereignties which they had so long protected against the Gaekwar, and now henceforth determined to protect against a British annexation. Under a treaty made with the Peshwa, in 1817, they might have annexed Kathiawar, but they resolutely refused to do so. They had busied themselves during the close of the 18th and in the beginning of the 19th century in a policy of disinterested protection. They had cried "hands off" to the powers at Poona and Baroda, and they now consistently denied to themselves what they had refused to others. The result was that the greater part of Gujarat was thus left to native rule, some 55,000 square miles being brought under a political settlement as foreign territory, and

only 12,000 square miles received from the Gaekwar, or the Peshwa, being incorporated in the British dominion. The chief acquisitions were those ceded by Baroda as the price of an alliance which had saved that State from the aggressions of Poona, and a few pieces of territory that fell to us after the battle of Kirki. To them was added, in 1839, a small patch acquired by the doctrine of lapse from Mandavi, and the Panch Mahals obtained from Gwalior, in 1860, by an exchange of territory, making altogether now 13,710 square miles, surrounded by Native States, and with numerous enclaves of foreign territory in the middle of the British districts. Baroda has, at the cost of considerable difficulty and friction, been taken from the political control of Bombay, but in the northern division of the Presidency there are still 46,407 square miles of Native States under the direct control of the Governor in Council. We shall presently see what difficulties are entailed by the policy which, highly commendable as it was, thus left Gujarat a patchwork of jurisdictions vesting in hundreds of different chiefs.

The central division was in a very different state from that of the northern when conquest transferred it *en bloc* to British rule. Here the Marathas had had a few years to consolidate their power. The districts had indeed passed through the same scenes of contest and disorganisation which Gujarat had witnessed, but the Peshwas had reaped the fruits of conquests won by others, and been able to construct some sort of system upon the ruins of others. The Dekhan was too far from Delhi for the Moghuls to establish firmly their authority in that part of India. The insane attempt of Mohamed Tughlak to colonise Daulatabad in the middle of the 14th century was followed by a revolution, and the creation of the Bahmini kingdom which lasted for some 170 years. There were then two considerable Hindu powers in the Dekhan, Warangol and Bijayanagar. The first was overthrown by the Bahminis, and when military factions brought the Bahmini kingdom to the ground, a Turkish general who had taken the losing side of the king carved out a kingdom for himself, and established the dynasty of Adil Shah at Bijapur. Four other Mohammedan rules were created on the ruins of the Bahminis, of which that at Ahmednagar, the Nizam Shahi, deserves mention. The Mohammedan powers then formed a confederacy and extinguished the remaining Hindu kingdom of Bijayanagar by the battle of Talikot in 1565. Next followed the inevitable quarrels among themselves, and the Emperors of Delhi, Shah Jehan and Aurangzeb, thought the time had come to restore the imperial authority in the south. All that they effected, however, was to break the power of the Dekhan Mohammedans and leave them too feeble to resist the Marathas. The Marathas having now acquired the Chout, or share of one-fourth on the revenues, in 1719, and fed upon the spoils of the Mohammedan kingdoms, in their turn decided, in 1724, to pursue the fatal policy of entering upon a contest with the Moghuls for the Empire of India. Then history repeated itself; for Ahmed Shah Durani, himself invading India, and destroying the Moghul Empire, scattered the invading hosts of Marathas at Panipat in 1760, and thus unintentionally opened the way for the British Empire as Aurangzeb had opened it to the Marathas by his conquests in the Dekhan. A second chance was now offered to the Poona Government. If the Marathas had now returned to their own country, healed their quarrels with each other, and governed the Dekhan properly, they might still have founded a powerful Maratha State. But the confederates, as Holkar, Sindhia, the Gaekwar, and Bhosle, were pleased to style themselves, met for the last time as vassals of Poona in 1796, and went off to seek their own profit, only lending support to the Peshwas in order to defeat the aims of another. Thus, when the battle of Kirki was won, the territories of Poona passed to the British with their legacies of internal strife and the ruins of capitals and walled fortresses telling the tale of successful adventure and profitable plunder, and inspiring the political hopes of a population, which trusted that the fall of the Peshwa would prove the revival of former dynasties, and the recurrence of disorder. One kingdom was at once reconstructed by the British conqueror—that of Satara, to which the Peshwas had banished the representative of the leader who had first raised the Marathas into a nation. This kingdom was annexed in 1848, on the failure of lineal male descendants of the Raja. A few other small States, originally only Jaghirs, still survive in the Dekhan, the chief of them known as the Satara Jaghirs covering 3,812 square miles. They owe their existence to the same cause which has covered Gujarat with Native States. They were protected by the British against the encroachments of Satara, and having been protected against others they were preserved by the British after the lapse of Satara.

The Expansion of the British Power.

A few sentences will suffice to tell the history of British advance, which in Western India is illustrated by no great military achievements. Surat was the first humble settlement of the British on the western coast. Off this city, Captain Best was attacked, on the tenth voyage of the Company, by the Portuguese in 1612, and the consequence was the grant, confirmed by the Emperor, in 1613, of a right to establish factories at Surat, Cambay, and Ahmedabad. Fifteen years later, Surat became the chief factory in Bombay. In 1664, Sivaji pillaged it, but Sir George Oxenden (the Governor) defended the factory so stoutly that the founder of the Maratha empire drew off, paying, however, the factory of Hubli, subordinate to Surat, two visits in the next few years. Bombay had been ceded to us in 1668, under the marriage treaty of 1661; and in May, 1687, the headquarters were transferred by Governor Sir John Child to it, from Surat The Government of Bombay used the independence of the Calcutta authorities, which they enjoyed until Warren Hastings became Governor-General in 1774, in strengthening their sea power, and their position along the coast. An alliance was made in 1733 with the Sidis of Janjira, formerly admirals of the Bijapur, but then of the Moghul fleet. The Savant Vadi State was induced to join in an alliance against the Angrias, who, having received naval command from the Marathas in 1690, and secured control over the Konkan from Kolaba to Vijayadrug, defied the Portuguese and English, and made pillage of the seas as the Maratha horsemen were acting on shore with their expeditions of plunder. In the middle of the 18th century, Kolhapur was drawn into the British system of coast defence, and Vijayadrug, the nest of the pirates, was destroyed. Bankote was acquired, and Salsette and other islands near Bombay were secured from the Peshwa, while the piratical Kolis of Taraja were subjected to the control of Cambay. The next move, after the pacification of the coast and the territorial waters, was to plunge into the intrigues of Poona. The disgraceful affair at Wadgaon warned the Government of Bombay that it was undertaking an enterprise beyond its military resources, and the real contest with the Marathas was provoked by events in which the Government of India had to act, and to settle in Mysore, in Central India, and at Delhi, the fate of a people who, in attempting to include Hindustan as well as Southern India in their hunting grounds, had neglected to consolidate their rule in the Dekhan, where they might have founded a strong kingdom. Accordingly, when the Pindharis forced the Government of India to settle once for all the limits of Gwalior, Indore, and Berar, and Baji Rao Peshwa, thus left to himself, proved himself unequal to the task of preserving order at Poona, the weak fabric of the Maratha Government fell with a crash, and the British, after the battle of Kirki, succeeded at once to the Peshwa's possessions in the Dekhan and in the Konkan. Bombay in an instant grew from an island, mistress of the Western seas, into a territorial sovereignty. Sir Evan Nepean was then Governor and President. Sind was added to it by conquest in 1843, Satara and Bijapur by lapse in 1848, and Kanara by transfer from Madras in 1862. The Presidency's control had already been exercised in the Persian Gulf, and Aden, after its capture in 1839, was included in it.

Difficulties of Administration.

This account may suffice to show the legacy of disorder which previous rulers of the province had left to the Government of Bombay. We became the inheritors of a Maratha kingdom, if such ill-assorted territories and claims could be called a kingdom. For the Marathas had never even set their own house at Poona in order. Mountstuart Elphinstone's report showed that Khandesh, north of the Tapti, was, at the time of our acquisition, "almost an uninhabited forest." "Its ruin," after the visitation of Holkar's force and the famine of 1803, "was consummated by the misgovernment of the Peshwa's officers." The Bhils in particular were "enemies of order." Ahmednagar, Poona, and Satara were in the hands of the Brahmans, who were "systematically oppressive when in power, and generally discontented" with the prospect of an authority that would interfere with their corrupt practices. The Maratha chiefs lacked their intelligence, but were equally rapacious and oppressive. The Maratha soldiers loved war, and saw that the hope of their gains were gone. "The faults of their government had created corresponding vices in the peasantry; oppression and extortion have taught them dissimulation, mendacity, and fraud." In the Karnatic, the people more readily welcomed their deliverance from the yoke of the Marathas, and seemed to be quiet and well affected. The revenue system, generally based, as it was, on sub-divisions of the Chaut, and most confusing assignments of shares in the crops, was collected mainly by

torture. The revenue officers were also judges and magistrates, and the Mamlatdars frequently released robbers, "allowing them to renew their depredations on the payment of a sum of money." Civil justice was, to some extent, administered by Panchayats, but what with delays and corruption, the parties rarely got satisfaction out of it. "Everything under the Marathas was so irregular and arbitrary that the limits of just authority can with difficulty be traced." The first thing was to establish order and justice, and to make it clear to the cultivator what he had to pay. If in the end, our system, built too little upon the village system and the machinery of Panchayats, at any rate it lost no time in turning to account the indigenous talent of the Brahmans, and educating in honesty a class of native Mamlatdars and judges who, under proper supervision, brought peace and prosperity to the harassed country. The jungle gave way to cultivation, the Marathas beat their swords into ploughshares, the roads were made secure for travellers, and the country settled down as a British province, with every sign of contentment. After a while, the settlement of the land revenue was made with the land cultivators for a term of thirty years, and numberless worrying cesses were taken off the shoulders of the ryots. One mistake was carefully avoided at the outset, and to the present day the Bombay system is the result of this foresight. The revenue officers having to deal direct with thousands of cultivators, were taught to spend most of the year on circuit in close contact with the people. Then whereas in other parts of India these officers go out occasionally and then draw a special travelling allowance, the Bombay collector and his assistants draw a permanent travelling allowance, signifying that their normal life is out in the districts. A habit of living amongst the people in the hot and cold seasons of the year is thus impressed upon all.

The Political Settlement.

The first difficulty, that of confusion and disorder, was overcome; and the next was to come to terms with the numerous petty States whom our policy had spared. They had fought with each other to the very last, but they soon found that the British suzerain would tolerate no further disturbances. It was necessary to fix the boundaries of their possessions, and this task—which it was contrary to the interests of the Peshwas to undertake—was without delay commenced by the British. The introduction of justice, revenue-settlements, and tranquillity into the British districts was an easier task than the political settlement of the Native States. The Bombay Government saw clearly the enormous disadvantage of allowing numberless jurisdictions to cross the path of the main arteries of communication, offering asylums to fugitive offenders, and refuges to smugglers of opium and spirits. But the resolution was deliberately taken and carried out—to show that the British were as strong to protect their own as to respect the rights of others. Determined that the petty States which clustered round them, or filled large areas (as in Kathiawar), should not fall into the vortex of annexation, the Bombay Government authoritatively introduced a political settlement. They divided the attributes of sovereignty into classes, assigning to every chief the measure of internal authority and the jurisdiction which he was competent to exercise, and, on his behalf, entrusting to British Agents the residue of jurisdiction or other power which the chief could not properly undertake. But although this great work of giving to each ruling chief a regularly defined position has long since been completed, and the complicated system of foreign jurisdiction, and political control is now well established, Yet the fact remains that an immense burden of political duties devolves upon the officials in Bombay which is unknown in any other part of India. It is true that the States are small, but petty chiefs are more sensitive than those of higher degree, and they are very prone to quarrel with each other. Even with the strong protecting British power there are constant difficulties to be solved. Few roads can be made in Bombay, few canals aligned in the northern and central divisions without a break of jurisdictional gauge. Patience, gentle influence and tact, are required day by day, to get native chiefs to co-operate with the Collectors of British districts in suppressing crime, protecting the revenue, pursuing and extraditing criminals, and securing the attendance of witnesses or defaulters. Let any one look at a map of Bombay, and see the streaks of foreign territory that run across so many British districts, and he will understand at a glance why the police are so costly and the administration of justice so frequently delayed. The cardinal difficulty of the Bombay administration lies in the number of Native States which British administration of policy has generously and honestly preserved from extinction. Their rules show year by year an

improvement in their administration, and a greater readiness to co-operate. They are loyal and friendly, but obviously a patchwork of jurisdictions involves some friction. Time will only allow me to mention one comparatively recent instance of this practical inconvenience. With all our insistence, we failed to stop the practice of infanticide in the northern division, because the Native States would not punish it. At last, in the seventies, an Act was passed enabling local governments to make rules for the registration of births, and for regulating expenditure on marriages. The Lewa Kunbis, in Gujarat, were great offenders, often ruining their families to secure a Kulia bridegroom, and where they saw no chance of that, putting their female infants to death. As only fifty-six villages held the Kulia families, and of them only thirteen were the homes of the real aristocracy, the supply of aristocratic bridegrooms was far below the demand. It is true that the Kulia bridegrooms made matters easier by other crimes. They squandered the dowries of their wives, then deserted them, and married others. But still scores of girls must go without Kulia husbands, and they were, therefore, systematically killed off. Government accordingly made rules fixing the dowries and the marriage expenses, but they could not introduce them until 1889, because the adjoining Native State would not co-operate sooner, snd even after its co-operation the desired result was not fully attained.

Turbulent and Discontented Sections.

We must pass on to the next special difficulty of Bombay administration, its turbulent classes and its thwarted hopes. Everyone has heard of Outram's work, in the thirties of last century, with the Bhils, in Khandesh, whom he won over by sharing with them the dangers of the forest, and by the force of his strong muscular Christianity. His successors have laboured abundantly in the same field, earning from these simple robbers the title of Raja, as did he who lately passed away —Raja Propert, of the Bombay Civil Service. Few people realise how troublesome the lawless classes may become. Twice in my service during the Parsi riots in 1873, and during the cow protection movement in 1893, have loaded cannon been placed at the head of the streets, and cavalry required to patrol the city for several days, so quickly can a religious spark spread among a combustible population, into a flame of fanaticism. The Dekhan peasants rose in 1873 against their creditors. In 1879, the Ramoshis under a Brahman leader a dismissed clerk, stopped the march and defied a large force both military and police for several weeks. In 1885 the low caste Talavias of Broach broke out and killed the superintendent of police. Gangs of Mianas have more than once, as in 1892, rendered life and property insecure in Kathiawar, and only been put down by British intervention at the cost of valuable life. So late as June, 1897, a band of Brahman fanatics murdered the Collector of Poona when the station was full of Europeans, the Kolis of the Ghats defied order in 1898, and a crop of dacoities broke out in Belgaum, Kaira, and elsewhere ; of agitations in Surat or in the Dekhan to resist the payment of taxes or rents several instances could be added. There is no reason to suppose that civilisation has yet overtaken fanaticism or predatory instincts in the Western Presidency, and as Lord Dalhousie repeatedly observed, "We must remember that we are tranquil because we are strong."

Nor must the influence of thwarted ambition be overlooked. The King-Emperor has no more valuable servants than the Brahmans of Bombay, but a man is wanting in imagination who fails to realise the disappointment which the overthrow of the Peshwa's government caused to that caste. They had put away to Satara the home of Sivaji which had created the Maratha power and divided the spoil amongst themselves. They too fattened upon disorder, doing nothing with the revenues of the country and leaving behind them in Poona not a single building which can compare with the least of the Bijapur or Ahmedabad tombs or mosques. I never look at Parbati without reading in its architectural poverty the doom of a sacerdotal supremacy which never built even a noble temple from the public revenues which it squandered. Nevertheless the Brahman rulers felt bitterly being weighed in the scale and found wanting. The spirit which moved the most infamous of them, the Nana Saheb, was not unnatural, and it is a force still to be reckoned with as the tragedy of 1897 showed. It is one of the legacies of broken empire with which the Government of Bombay must reckon, and by education, firmness, justice, and tact much has been done to meet the difficulty. But beneath it lurks danger in times of trial and disturbance which no prudent man can afford to make light of.

In Bombay city the religious discord of the East is often strongly marked. Shias and Sunnis, Wahabis and other Mohammedans, Hindus and Mohammedans, and Mohammedans

and Parsis not infrequently come to blows, and the rough sailors of Arab or Sidi extraction constantly require firm handling. For this the Government must be prepared, and its police force must be organised for the exceptional work required of it.

Former Greatness of Bombay.

Bombay to outward appearance has lost much of its early greatness. Within my own experience it expressed an opinion upon Persian affairs, receiving from Teheran the despatches of the Minister, and transmitting them to Calcutta with any observations. In the Persian Gulf and Muskat it literally laid the foundation of British influence, bringing the piratical tribes to order and establishing almost a protectorate over Muskat. The most important treaties were suggested and negotiated by it. Of course, improved communications have altered matters, and it was a prudent action on the part of Sir Philip Wodehouse to resign an authority over the Gulf, which in the sphere of foreign relations properly belonged to the Supreme Government. But it is right to remember that so long as the Government of Bombay had charge of Indian relations with the Gulf, the foundations of our position there were wisely and firmly laid. Zanzibar passed out of the control of the Government of Bombay, in 1872, although the former order of things has left its traces behind in the jurisdiction still exercised by the High Court over British subjects and their property there. The Somali coast, moreover, was under Bombay until 1898, and resolutely did the Governor in Council refuse to indulge in expeditions into the interior, or to extend British protection to regions into which military force could not penetrate. The ruling principle was to hold the coast and the forts, develop trade, and punish severely any attacks upon the coast line. Aden, however, and Perim are still part of the Presidency, but within recent years the direction of affairs outside the small British territory in Arabia has gravitated towards the Government of India. Within India itself Bombay has lost the political control over Baluchistan, which it first established when Lord Dalhousie answered the menaces of Russia during the Crimean war by despatching Major Jacob to negotiate a treaty, which brought the Khan of Kelat into the Indian Protectorate in 1854. Upon that solid foundation all our subsequent relations have been built. Finally, Baroda used to be under the political supervision of the Government, which from the first established relations with the Gaekwar, and still has to deal with innumerable questions arising from the complicated and intricate claims of Baroda upon its neighbours. Much administrative friction would be saved by the restitution of this small political charge to the Government of the Western Presidency.

The Future of Bombay.

But although the Government of Bombay has been shorn of many of its former responsibilities and powers, the guardianship of the western ports of India, the development of its capital city, and the welding together of the numerous races and distinct portions of the province are a satisfying and honourable task for its Government. The broken history of the geographical area called Bombay has left its mark upon the land tenures, which vary considerably. The ryotwari settlement in the Dekhan has swallowed up many distinctions of Mirasdar and Upri tenant, but the Talukdars in Ahmedabad, the Narvadars, with their joint responsibilities in Kaira, the Bhagdars in Broach, the Mehwasi Patels on the Mahi, the Máleks in Kaira, the Khots in the Konkan, the Inamdars, and the Sarinjamdars of the Dekhan, represent a variety of proprietary rights which it would puzzle this Society to describe, and which entails a very severe strain upon the Bombay Civil Service. If to this be added the different dialects of the Presidency, especially Kanarese, Marathi, Gujarathi, Hindustani, and Sindhi, it can easily be imagined that the task of administration and of education calls forth an abundance of effort. To that effort, the public services and the mercantile community of Bombay, who, in an indirect way, bear part of the white man's burden in India, have nobly responded, and the proofs of their success are written in the statistics of every annual administrative report. For it must be recollected that famine is always with them and, of late, plague has been added to their cares. Probably the most common topic of speculation concerns the form of the Government. The question of converting the Governor in Council into a Lieutenant-Governor, is frequently discussed, and very often with insufficient knowledge. No doubt some of the other provinces of the Empire have flourished exceedingly under their civilian rulers, men trained in the local services, and well acquainted with the wants of each province. Among Bombay Governors, perhaps the most eminent were the three civilians—

Frere, Temple, and Mountstuart Elphinstone. Certainly the last-named was the greatest of all her Governors. Nor is there any reason why Indian civilians should not, from time to time, fill the post, and Lord Dalhousie, in his famous minute on the Government of India, wrote :—

"As the servants of the Crown, on all sides of polities, have united of late years in selecting servants of the East India Company, not only for Indian governments, but even for the office of Governor under the Crown, as a Governor of Jamaica, a Governor-General of Canada, and a Governor of Mauritius have been taken from Bengal; and as another Governor of Mauritius, a Governor of Ceylon, and a Governor of the Cape of Good Hope have been selected from Bombay, I cannot doubt that Her Majesty's Government will make no objection to confirming similar officers in the local Government of India, for which their local experience and training render them even more eligible than for the administration of the Colonies. I am very confident they will not reject the proposal merely because it may tend to place a certain inconsiderable limitation upon the exercise of public patronage."

But while the system prevails of usually sending out to Madras and Bombay, a governor who has no previous knowledge of Indian administration, it is well to remember that it possesses some advantages. It provides India with a statesman, in the confidence of the Government, who is eligible for the post of Governor-General in an emergency. It imposes some check upon the dangerous tendency of over-centralisation, by placing the home authorities in direct communication with the governors, whose opinions upon Indian affairs must always be of value, and it ensures to the population of the presidencies the application to their concerns of an impartial open mind, free from any preconceived ideas. India is too vast for one mind to understand or grasp the whole of it. Bengal differs in numerous respects from Bombay, as Madras does from the United Province of Agra and Oudh. The Governor-Generals in council cannot always have by their side experienced advisers upon Western India and Southern India, and the experiences and traditions which do surround them, are alien to those of the west and the south, and, therefore, often misleading. It is wise to have various systems of government in vast India, and since the Government of India is not intended by Parliament to administer the whole Empire, but is charged with control and supervision over all its parts, it is well that it should be able to compare the effects of different systems. So long as a province can show, after a century's administration, the moral and material progress achieved in Bombay, reformers may hesitate to change materially a system which is rooted in the past, valued by the governed classes, and justified by results.

DISCUSSION.

The CHAIRMAN was sure the audience would allow him to express to the author on their behalf their thanks and congratulations on the admirably clear and lucid paper he had read. If anybody did not know that the author was a very vigorous and admirable public servant in India, they would, he thought, assume he had gone out there on several tours as an amateur photographer. When he (the Chairman) was the author's guest at Bombay, Sir William Lee-Warner brought home to him vividly his enthusiasm with regard to ancient architecture and the objects of interest which he had exploited in the Bombay presidency. He (Mr. Brodrick) valued the opportunities which the Society of Arts gave to those who had not lived for a long time in India, and had not a permanent tie to the country, of gaining some knowledge of the history which, althongh it could be learned from books, was not learned sufficiently, of the architecture and antiquities of other parts of the world, and, above all, the present administration of the most successfully governed Asiatic State which the world had ever seen. When one thought that in the 18th century England was governing Ireland, not too successfully, because there was comparatively so little progress to show for it, one could realise what had been achieved in India in the 19th century amidst the chaos and confusion which the author had so well described, in which, in one presidency alone, three hundred and fifty-three different systems of laws had to be dealt with. He thought too little attention was paid by Englishmen as a rule to the devoted services of those who gave many years of their lives in not always the most favourable climate or surroundings to carrying out, quietly and unobtrusively, but most successfully, a system of government which was a pattern to the civilised world. The author had admirably touched on the blending of expert knowledge with other external administrative power which was seen in the Government of India. It was quite true that, as in the case of the presidencies, so in the case of the supreme Government at Calcutta, England had only intermittently relied for its governors on those who had had local experience, and who had been brought up in the service of India. But there had been rare exceptions, exceptions not so rare in Bombay as in Calcutta. England had in Lord Lawrence a Viceroy who had marked himself out by his great success in previous administration. He thought they might claim also that the present

Viceroy was a man who, in addition to his great industry and capacity, and a love for India which had made him subordinate every other consideration to the government of India, had given the best part of his life before he went there to the study of Asiatic questions, customs, and travel. He thought that was from time to time a useful alternative to the sending out of men who, however otherwise qualified, might not have personal acqauaintance or previous experience of the matters to be dealt with. He had ventured to make the few remarks he had made merely to show his appreciation of the most excellent address to which they had all listened. He deeply regretted that owing to another engagement, which he had made before he was asked to take the chair at that meeting, he could not stay to hear the discussion.

The chair was then taken by Sir GEORGE BIRDWOOD, K.C.I.E., C.S.I., LL.D., M.D.

Sir GEORGE BIRDWOOD, in opening the discussion, said, he always on such occasions regretted the accident—as was presumed—which had led mankind in some preterpluperfect prehistoric stage of their existence to give up the notification of their feelings and thoughts by the blind impulsive gesture of their arms and legs, for the comparatively quite modern mode of so doing in language, *i.e.* the artifically specialised wagging of the tongue in front of forced currents of pulmonary expiration ; a most perverse abuse of the proper use of the tongue as the ordained organ of taste! It was so natural, spontaneous, easy, and altogether congenial to speak, since the word etymologically means "to thunder," applause with one's hands or heels, or to express, since it means "squeeze out," dissent with a contraction, or shrug, of the shoulders; while nothing was more difficult than to do so by means of our present highly sophisticated fashion of vocal and verbal utterance. The difficulty is greatly aggravated when your criticisms have to be addressed to an audience face to face with the object of them. In the present instance he was further oppressed by the sense of presumption in venturing on any criticisms of the notable paper that had been submitted to them that afternoon:—"Who am I that I should attempt to raise my feeble voice—even in deferential commendation,—the fullest and heartiest indeed—of Sir William Lee-Warner's notable paper?" Ever since the death of Sir Bartle Frere Sir William Lee-Warner has stood in the eyes of Bombay men, of all nationalities, classes and conditions, as a pre-eminent illustration of that combination of ability, accomplishments, high public spirit, and strength of character, which had for over a century of strenuous probation been the typical distinction of the Indian Civil Service. Of both Sir William Lee-Warner and Sir Bartle Frere it might equally be said:—"Quid vult, valde vult": and than that no man has a higher claim to the confidence of his fellow-men, and the homage of their recognition and loyalty. He was quite unprepared for Sir William Lee-Warner's treatment of his subject. He had anticipated a physiographical sketch of Western India, and some detailed descriptions of the more picturesque aspects of its inspiring landscape, and joyous life, and artistic labour; and that his own observations on the paper would have recalled the intoxicating pleasure with which he renewed in 1854 his unforgotten impressions, received in 1832-39, of the wonderful flowering trees and shrubs, and fascinating general plant physiognomy of the unique and incomparable terra-marine* Presidency of Bombay, high uplifted above the sea on ten thousand basaltic pinnacles and crags. But if he wandered back among these reminiscences, he might well be asked,—"Quid ad Mercurium?" Yet if he followed Sir William Lee-Warner,—the scope of whose paper was far beyond his proper tether—his idiot-cy—he was sure to ask himself with even truer pertinence,—"Where am I straying?" He would only say that he had never read a more comprehensive, convincing, and impressive exposition of the political and administrative history of the Bombay Presidency than that given them that afternoon in his all too brief paper by Sir William Lee-Warner. As a journalist he (Sir George Birdwood) had always advocated Bombay being made the seat of the Government of India,—because of its comparative appropinquity to Europe; its immediate continguity with the valley of the Indus, and of the Tigris and Euphrates; its obvious opportunity,—in its glorious harbour,—as the Emporium—[as it ever has been, first at Calian in ancient times, then at Tanna in mediæval times, and since our modern times at Bombay itself]—of the immemorial and opulent sea-borne trade of Persia, and Arabia, and Eastern Africa; and above all because of the manly and independent character of the Mahrattas and Parsees. But he had never grasped before that afternoon how strong were the merely sordid economic arguments in support of the transfer of the Government to the Town and Island of Bombay. Still the supreme argument in favour of Bombay lay in the preponderance of its valorous and patriotic Mahratta people, the Scots of India. There are other native races as hardy and brave—the Gurkas, to wit; others as full of religious fire,—the Sikhs; and others as intellectually keen, and redoubtable with the pen,—as the Bengalis; but there is no other indigenous Indian race at once so heroic, so devout, so romantic, so passionately patriotic and with so quickening a literary past and present, as the Mahrattas; and it is amidst such a population that the British

* In the physiographical nomenclature of botanists, the Malabar Coast is distinguished as "India æquosa" from the Deccan, "India vera," the once trinacrian island of basalt [Bombay] and granite [Madras], separated from the Alps of Central Asia by the broad strait now represented by the valley of the Indus, "India deserta," and the low-lying, humid valley of the Ganges, "India diluvia."

Viceroyalty in India should be established, as on a throne of adamant. There is no loyalty when it surely, however slowly, comes at last, like that of men, such as the Scots, who are first loyal to themselves, and their own fatherland, and its traditions. On the other hand the Governor-General should not have his head-quarters among the mild tempered, however quick-witted, and artistically sensitive, people of Bengal; who sprung from an alluvial country, panned out on an immense extended dead level, take their Government lying down; just as they take their great God Jugonnath, when in solennial procession his high towered triumphal cars are rolled over their prostrate bodies. That sort of atmosphere, evaporated from an undrained fluviatile subsoil is not one that should be breathed by rulers of British blood. He had only two suggestive criticisms to make on Sir William Lee-Warner's paper. Many who read it in the *Journal* would be grateful if, where he mentions the more obscure native names of places, and obscurer revenue terms, he would parenthetically add their meanings. The phrase "Manjha in the Panjab" for instance. Manjha is the Sanskrit *madhya*, "midmost," as the land between any village and the boundaries of conterminous village lands, "the hub of the universe" of each village; and in this place it is the land round about Lahore, the cradle of the most warlike and renowned of the Panjabis. Again, take the passage, "Baji Rao in 1756 compelled Baroda to admit the claim of Poona to half the chout." This seeming outland word, is really cognate with our words chess* [into which *shah* "King," and *sheik* "chief" also enter], checquer, exchequer, cheque, &c., being the Sanskrit *chouthâi* [*chaturtha*], "one fourth," and here refers to the fourth part of their revenues exacted by the Mahrattas from the panic-stricken Hindu and Mahometan princes of India for refraining from periodically ravaging their territories. The *suhotra*, or "one-sixth" of the half Chouth surrendered to Baji Rao by Baroda, paid to the then Pant Sacheo of Bhor, is still, he believed, continued to the Pradhan of that "Jujube Tree" State by the British Government. Lower down was a cluster of revenue terms: Mirasdar, the holder of an hereditary state; Talukdar, the holder of a district, and the collector of its revenues; Narvadar, the holder with others of a share in village lands. Bhagdar, a similar share holder; Sarinjamdar, literally "provider," the holder of a *jaghir* ["place (*i e.* land) grabbed," "gripped,"], or village and its revenues, with the obligation of maintaining a proportionate number of troops in the service of the State; Inamdar, the holder of a grant of land free of all service, rent, or tax of any kind; Patel [compare the Babylonian and Assyrian *patesi*, and "pater"], the head of a village, a rural mayor; Malik, "lord," as in Moloch, Melchisedek, Ab melech, and here proprietor; "Upri tenant,"—upri being the Greek *hyper* [compare *ubris* "uppishnen"] and *hypo*, the Latin "super," "supra," and "sub," "subter," and our word upper, with the meaning not only of "upper" and "above," but of "surplus," "extra," "exotic," "foreigner" [compare "over-er" applied in the Isle of Wight to all people from the contiguous twin-island of Great Britain], and here applied to an "outsider" admitted into a village community as a "tenant at will;" and finally Khote, originally a farm, then a farmer or contractor of revenue, and then an hereditary collector, who gradually usurped the rights of proprietorship in the lands he "farmed." The same word slightly differently spelled means "a brick," "an enclosure," "a granary," "a treasury." Similarly our words cot and coat are one and the same word, differently spelled; coat being the cot we wrap ourselves in, and cot the coat in which we dwell; and all these four words are one and the same word, which goes back to a root *kuoh*, "to cover," "protect," "conceal," from which comes the Sanskrit *kavi*, "a wise man"; and with a prothetic a, the Greek *akouo*, "to be observant," in a wary and protective sense, *kouo* also occurring in such names as Laocoon, the "People's Protector"; the Latin "cautus," "custos"; Italian *cotta*, a peasant's smock frock, and French *cotillon*, a "petticoat," *i.e.*, little coat, also "an apron." You see when you dissect them, all these words are gorged and glutted with meaning,—and with interest when you come to know their meaning. It reminds one of the autopsy of a hypercoristic alderman. In the first paragraph of his paper Sir William Lee-Warner would appear not to appreciate sufficiently the public worth of Cook's "personally conducted" tourist in India. The matter of fact is that an advantage results to the Empire from the visit of every Englishman to India. The great danger in India, as in Russia, is the immeasurable gulf fixed between the Government and the people. The danger is the greater in India, because the Government there is ultimately the Government here. The whole organisation of Indian life is religious and theocratic; and Hindu life in particular is a "Civitas Dei," not only in its ideals and theory, but in its working reality. Everything

† *Chatur-anga*, "four-bodies", infantry, cavalry, elephants, and chariots, is the Sanskrit for the royal game of chess. This becomes the Persian *citranj*, and *citranji*, a rug, patterned in squares like a chess board. The cognates of *chatvar* "four" are the Greek *tessares*, *trapezion*, *tetrarkes*, &c.; the Latin "quatuor," &c.; the Spanish and Portugues *Xedres*, "chess"; French cahir, a "quire" of paper; *carillon carême* ["quadragesima"], *caserne*, *quadrille*; and English square, squadron, quarrel, quarry, &c. Now the Persian for King is *Shah*, and the Arabs in borrowing the game of chess from the Persians, mixing up their own word *sheik* "chief" with *shah*, called the King in chess, something between *shah* and *sheik*, which in European mouths became *eschec*, *jacque*, and check; the phrase of the game, "check-mate" being none other than—your "King is dead." Then once more from the squares of the chess board, the empire of the King, came our words "cheque," "exchequer," "shot"; words which through *shah* trace back again to Xerxes, *pasha*, *kshatrya*; and to *khet*, the Hindustani for "a field." Could any game of hide and seek, or any seeking for hidden treasure be more viciously fascinating?

is divine, everything sacramental, even immorality and crime: and until this is recognised by us, and marked, and learned, and digested, and, to some extent,—to some conception of it at least, even of its immorality, and criminal instincts,—assimilated, we shall never rightly understand, or helpfully sympathise with the people of India, and never shall be understood by them, or command their frank affection. Every contact with them therefore helps on, he would not say the better, but the happier Government of India. Cid Abdurhaman bin Abdur Sadik, the Moorish Envoy to this country in 1902, on leaving London on his return to Fez, replied to the adieux of an English friend:—"Yes, London is indeed a great city, but I shall be glad to get back again to civilisation." His actual phrase for civilisation was,—"the peace of God." In the seething whirl of the wild mad rush of life in London he had found no time for prayer; for a good Muslim must not only pray in due form five times a day, and if at leisure eight times, but "waking or sleeping, standing or sitting, he must (in spirit) ever be steadfast in prayer." One of their sayings is:—"Prayer is the very marrow of life." When some years before another Moorish Envoy was in this country, and was lionised everywhere, and shewn all the wonders of London, nothing moved him,—for nothing touched him. But on being driven down one morning to Greenwich, and coming, at a turn in the road there by the Park, upon a lovely Laburnum tree in full flower—it was the great year all over London for Laburnums—he at once stopped the carriage, and stepping down into the road, adored, after the ritual of his religion, the holiness, the power, and the mercy of God, in the creation of so beautiful a tree. The following year was the great year, in and about London, for Roses, and the Khedive was among us. Those of you who use the asphalted path—from the associations of 33 years I call it the "via sacra"—leading from the steps below the Duke of York's monument to the India Office, will have observed a little after it crosses the new "Processional-road," the succession of green plots recessed, as if side chapels, into the serene sylvan sanctury of St. James's-park, each set with one or more clumps of mixed sweet briar, briar roses, and dog-roses, like so many rural altars to the Goddess Flora. They were in their fullest and most delectable bloom, when one morning as I was walking down to the India Office, two young Egyptians in the service of the Khedive, who were advancing toward me, struck by the apparition of their fresh, and bright, and winsome loveliness, suddenly halted, gave the flowers a military salute, and then straightway went through the immemorial genuflexions and prostrations observed by Muslims in giving Glory to God in the Highest. What I was thinking of at the very time was of Qneen Guinever out "a-maying in the meadow which is beside Westminster," and of Sir Lancelot "doing battle for the Queen against Sir Mador," in the lists enclosed a little lower down by Storey's-gate; and again of Sir Lancelot riding down to the steps under the clock tower of St. Stephen's Palace, and thence "swimming his horse across the Thames to [where Doulton's potteries now are] Lambeth." The first sight of fine scenery, and of flowers of strange splendour, or rare grace, stirs Europeans as profoundly as Asiatics. But what European would spontaneously and frankly prove his emotion in the same devout manner. When Bonpland first saw the gorgeous flowers of the *Victoria regia* floating beside his raft, his blind impulse was to precipitate himself after them into the Orinoco; and he was only saved from so doing by the presence of mind of his companions. In my "Mahratta Plough," which Sir William Lee-Warner has mentioned in a manner that highly honours me, I have described my scandalous conduct, into the scandal of which I led in a pell mell charge, a whole column of European troops, at my first sight, on returning to India in 1854, of a gigantic Silk Cotton Tree, standing in full bloom, like a mountain of living rubies, on a grassy slope of the Ram Ghat, just then being lighted up by the rising sun. I think I also describe in the same article my riduculous antics, in absolute solitude this time, when I first saw, on the lower slopes of Prabul, opposite Matheran, the *Hoya viridiflora*. Before I knew what I was doing I was off my pony and turning "cart wheels" round and round the magically green flowered scandent bush. The performance may, it is to be hoped, be explicable by the hypothesis of heredity, and that for the moment I had reverted to some as yet speechless and gesturing ancestor in the respectable act of Sun-worship. But seriously, the rapture with which I was seized at the sight of the Silk Cotton Tree and the *Hoya viridiflora*, was in itself,—in its instant if only momentary recognition of the divinity in which all nature participates,—not the less an "act of adoration," because of the crude and unseemly forms in which it was objectively presented; and it is from the pure joy and supreme peace of such exceptional experiences that an Englishman comes to understand the secret of the simplicity and serenity of the lives of the Hindus, and the unfailing dignity of the Muslims. In Europe we locate our fairy realms some vague where at the meeting line of the distant land and sky: but the Asiatics,—he meant of Anterior, and Central, and Southern Asia,—have their actual present life in the mysterious internal consciousness which is the meeting point of earth with heaven, where nothing is common or unclean, and everything, even the most familiar and unregarded, is divine. This is the secret of their inmost being, and this is the key to the hopes and aspirations, and the motives, of their otherwise inscrutable natures. In conclusion he would only repeat that while naturally shrinking from expressing anything like a presumptuous pleasure in, and praise of Sir William Lee-Warner's masterful paper, no one had listened to it with greater instruction and gratification than himself; and add that as one of those who had joined in pressing him to read it, he would ever remain grateful to him for it.

Sir M. M. BHOWNAGGREE, K.C.I.E., M.P., expressed the pleasure with which, as a Bombay man, he had listened to Sir William Lee-Warner's masterly paper. He was struck with the comprehensive and able manner in which Sir William had treated a very expansive, if not a difficult subject, which in itself was a splendid vindication of the position of the Chairman of the Indian Section of the Society, which he occupied. He had claimed for Bombay the foremost position in India, and as an old Bombayite, it gladdened his heart to think that he had done so. The Bombay Corporation, at its inception, started with a motto which was regarded as rather conceited, viz., "Urbs Primus in Indis." That had always been regarded by men who belonged to other parts of India, as rather a boastful and arrogant assumption, but now that the days of the old warfare were over, and Bombay had become for India the gateway to all that was civilised and benevolent that came from the West, with its cosmopolitan population and geographical advantages, he believed that whatever might be said of other parts of India, Bombay was, on the whole, the most interesting and the most important portion of His Majesty's Indian Empire. Sir William had referred to the evolution of Native States as at present constituted under the British Government, and said "The cardinal difficulty of the Bombay administration lies in the number of Native States which British administrative policy has generously and honourably preserved from extinction." At the present day, the Native States found a field for the exercise of the ability of native statesmanship, and ran in a line with all the best traditions and methods of British government. He believed that the existence of the Native States might be regarded as one of the triumphs of British administration. It was quite natural that in controlling so vast an area of different segregated States there must be difficulties of administration; in fact Indian administration was a difficult problem, otherwise it would not be worth having for the British Crown. But difficult as that administration was, he thought nobody present, or anyone connected with India, would admit with greater generosity than the author himself, that the Native States to-day formed a bulwark to the power of Great Britain in India, and that they were willing to run alongside of all that was worth imitating in the British methods of administration, if properly guided into that line. There was not much time left to allude to the many subjects treated by Sir William, but he would briefly refer to Aden, because he wished the new Secretary of State for India to know that the people of Aden regarded with great concern the prospect of that place being taken from the administration of India, and passing under the Foreign Office. He had the testimony of prominent men in Aden that they regarded any such prospect with great concern; that they believed that their interests could best be safeguarded under the Government of Bombay and the Government of India, and that if Aden was taken away from the supervision and control of Bombay it would be a matter of regret to them. He was greatly struck by this sentence in the author's eloquent address:—"But the point on which I now wish to insist is the tale which the builders of these relics tell of a Mohammedan rule raised upon Hindu foundations, and of conquerers forced by the strong influence of the place and its inhabitants to alter their rigid rules, and become partners with the conquered, even in the solemn duty of expressing in stone their laments for the dead or their devotion to God." That was a sentence which was both generous and inspiring. The author had brought out one of the main features of the influence of Mohammedan rule over the conquered Hindu subjects, and remarked that the conquerors, had become partners with the conquered, even in the solemn duty of expressing in stone their laments for the dead, or their devotion to God." The day of building great temples was passed, the day of conquest by sword was passed. Thanks to the protecting hand of the British Government, there had succeeded a period of settlement and of peace, and, he hoped, of prosperity for India. He prayed that in this new order of things, by the exercise of generous methods of statesmanship, by the sincerity of their advocacy of Indian interests, by both Indian and British statesmen doing what they could to remove such a blot from British administration as at present existed in the colonial treatment of British Indians, that, under the blessing of Providence, her administrators would become "partners with the conquered" for many centuries to come in all that might tend to her future welfare and greatness.

Sir CHARLES CECIL STEVENS, K.C.S.I., thought it was right that someone connected with the Bengal Presidency should come forward and thank the reader of the paper for the lessons he had received. He rose because he could now see no other Bengal man in the room and he trusted that he would show all the humility becoming to a position of such numerical inferiority. Sir William Lee-Warner had provided a sort of antidote to his brilliant paper, for he had exhibited a map of the whole of India, which the speaker thought restored Bombay to its real dimensions. He had been comforting himself, on looking at the map, by finding how, after all, the Presidency of Bombay comprised but a comparatively small part of India; and he began to recover his self-respect when he thought that the rest of India after all did exist for something more than unfavourable comparisons with the fortunate province which had been the subject of the paper. He was happy to see that Calcutta appeared large on the map, even larger than Bombay, but no inter-provincial feeling would prevent any Bengal man from tendering his very best thanks to Sir William Lee-Warner for his able paper.

Mr. J. D. REES, C.I.E., after congratulating the author on his able paper, said Sir William Lee-

Warner had said that persons from other provinces regarded the title, "Primus in Indus" as "rather conceited," but he ventured to remark that what the other provinces thought was not that it was rather conceited but that it was exceedingly characteristic. The author claimed a population of 450 to the square mile in parts of Bombay as being one of the densest in India.

Sir WILLIAM LEE-WARNER said that he had stated that it was the greatest in the Bombay Presidency.

Mr. REES accepted the correction and remarked that the population of part of Cochin was 1,920 to the square mile. With regard to the ruins, he fully agreed that the ruins of Bijapur were the finest he had seen in India; but when the author claimed that Bombay was the most educated province he would like to put him to the proof of figures, because he believed the Province of Madras could raise up its head on that score, and that the race for first place was between Madras and Bengal. He believed the literate population was higher per thousand in Madras, but as he had not a perfect recollection of the recent census returns he would accept Sir William Lee-Warner's statement if he said it was correct. When the author said that Bombay was the largest contributor to the revenues of the Supreme Government he was greatly astonished, because he believed an unusually large proportion of the revenues of Bombay were spent, in the Presidency for instance, upon the buildings, in regard to which he had said, "That's the way the money goes." Sir William when describing the photographs, said, "Here is a university, there is a railway station, and if you go along far enough you come to a court." In point of fact he believed they would come to the Bankruptcy-court, and they very nearly did go there. When there was a famine in the Bombay Presidency they were driven to live upon grants from the Supreme Government, a fate which had never happened to the sister provinces. Sir William Lee-Warner had also said that the amounts in the savings banks per head were very high in Bombay, but possibly they were as high in other parts of India. He disputed altogether that that was necessarily a test of prosperity, because if that was taken as a test Sweden would be the most prosperous country in Europe, while from personal acquaintance he knew it to be a poor country. He believed the reason why the deposits were so high was because it was such a poor country as to have few banks. He most heartily endorsed all the author said in regard to the Native States, and deeply regretted the way ex-collector residents, with ex deputy collector dewans set to work to reduce everything to their own ideal of their own collectorates. It made him think, when Sir William Lee-Warner regretted Baroda had been cut out of Bombay, how uncomfortable he must have been when the able Resident of Mysore, which was so unjustifiably cut out of the Madras province. Further, he wished to ask the author whether the extreme confusion which he so vividly described as existing in anti-British days implied a corresponding amount of misery on the part of the people of the country, because, having spent some time as a student of ancient Indian history, he very much doubted whether in the past the people were so miserable as represented, though doubtless far more wretched than they were now. He had often written on the subject, utterly rejecting the theory that England had made India poor, but at the same time he thought they were apt to conclude that, because there were contending factions in India, therefore the people were ground down. It was found, from contemporary records, that very often the natives went on ploughing close to battle fields, merely stopping to inquire who had won the day and who would collect the taxes. He thought that conveyed a very great moral which, in dealing with the history of India, should never be altogether absent from their minds. Nor did he follow the author when he said that with regard to the Governorships of Madras and Bombay they afforded any basis for useful comparison, because in point of fact, the administration in its essentials was just the same in the governorships as in the lieutenant-governorships. Nor could he see why a capable local man should not be available for the presidencies as for the provinces. He was not asking for the abolition of the governors, but did not understand the grounds on which they were differentiated. When the author showed the photographs of the beautiful buildings, he thought to himself that he would rather see as much money as possible left in the pockets of the people than that it should be expended upon such magnificent erections.

On the motion of the CHAIRMAN, a hearty vote of thanks was unanimously accorded to Sir William Lee-Warner for his paper.

Sir WILLIAM LEE-WARNER writes:—In deference to the Chairman's suggestion, I refrained from offering any reply at the time to those who so kindly criticised my paper, but it may seem to be discourteous if I do not submit a few remarks for incorporation in the report of the discussion. I have not contended that the Presidency of Bombay contributes absolutely more to the revenue of India than any other province, and I am aware that even in the figures which I gave, as taken from official returns, some part of the taxes or payments received in Bombay are actually paid by the population of other provinces. But no other province of India pays per head of population a larger revenue, and nowhere else are the results of administration equally fruitful in statistics of the Education and other departments. At the same time, no other province of India emerged in so short a period from a state of confusion and disorder which was without a parallel elsewhere. In dwelling upon the difficulties

of jurisdictional break of gauge, and a multiplicity of Native States, I do not overlook the great value of native principalities. A union of hearts with so many hearts to win is not attained without some jealousies and heart-burnings. The loyal Sovereigns of Bombay have done much to co-operate with the paramount Power, and, year by year, are improving their methods of administration. But it is right that they should recognise the difficulties of British administration, and the profit to themselves of giving something in return for the protection which they enjoy. Much has been done, but much remains to be done, especially in their police departments. My plea for the restoration of Baroda to the control of the Government which manages its neighbours, is based upon administrative convenience, not upon sentimental ideas of prestige. Baroda, and at least one hundred other States in Gujarat, are, with the British districts, parts of one whole, woven together and united by indissoluble ties of administration. Friction must be caused by placing the parts of one division under different heads. I must plead guilty to not having explained revenue terms, but a mere translation of phrases would have conveyed no meaning. My object was to touch lightly upon the confusion of tenures, so as illustrate one of the local difficulties of administration. To have attempted more would have unduly tried the patience of my audience.

SEVENTH ORDINARY MEETING.

Wednesday, January 27, 1904; DR. FRANCIS ELGAR, F.R.S., member of the Council of the Society, in the chair.

The following candidates were proposed for election as members of the Society:—

Findlay, Archibald, Mairsland, Auchtermuchty, Fife, N.B.
Garnett, Miss Annie, Fairfield, Windermere.
Kendal, Frank, 428, Strand, W.C.
McKerrow, H. B., Eversley, Wilmslow, near Manchester.
Oatway, George Henry, The May-Oatway Fire Appliances, Ltd., 49, Queen-street, Glasgow.
Stocken, Alfred, 144, Fulham-road, S.W.
Stovold, Herbert William, A.I.E.E., British India Steam Navigation Company, Ltd., Bombay, India.
Vickery, John Collard, 179–183, Regent-street, W.
Voegelin, Albert, M.A., 35, Castelnau-mansions, Barnes, S.W.

The following candidates were balloted for and duly elected members of the Society:—

Barzano, Carlo, 6, S. Andrea, Milan, Italy.
Read, William, A.I.N.A., Camber Slip, Portsmouth.
White, Samuel, Dorset-house, Clifton, Bristol.

The paper read was—

ICE-BREAKERS AND THEIR SERVICES.

By ARTHUR GULSTON.

In the Northern Hemisphere of the world, there are many ports which during winter become closed to navigation, and choked with ice owing to climatic conditions. To free these ports, and render navigation possible throughout the winter, resort has been made to a class of steamer, called "ice-breakers." These are of many forms and dimensions, varying from a steam launch 40 feet long, spoon-shaped at the bow like a Norwegian "pram," to the enormous *Ermack*, of 8,000 tons displacement and 10,000 horse-power. These ice-breakers are placed on their various stations to assist steamers of the commercial fleets, which become fast in the ice, and which, without assistance, are unable to free themselves, owing—in most cases—to insufficient horse-power, and the light scantlings of their propellers. These vessels also run considerable risk of sinking, owing to the ice squeezing and holeing their sides.

In this paper, it is intended only to deal with vessels that work amongst ice that is formed from year to year.

There are in Canada and in the Baltic, many merchant steamers which can cope with ice of considerable thickness, and the ice-breaking mail boats of Helsingfors are fine examples of this type; but without the aid of "ice-breakers" proper, the work of the commercial fleets in winter would indeed be sadly crippled.

Railway ferry ice-breaking steamers are another type, and they play an important part in keeping open railway communications where bridges or viaducts are more or less an impossibility.

The first recognised "ice-breaker" was a tug called the *Pilot*, of Cronstadt, belonging to a Russian gentleman named Britneff, who wished to keep the ice from fastening inside and outside the breakwater at Cronstadt, and to prolong the trade with lighters to St. Petersburg at the setting in of the winter for a longer period than had previously been possible. With this in view, a new bow was built on the vessel, and in 1870 she was set to work. She was also used to keep a canal open through the ice between Cronstadt and Oranienbaum, the present railway terminus on the coast, during the time of the formation of the ice. Before this vessel began to work communication to and from Cronstadt and the mainland was impossible for some time during the formation and breaking-up of the ice. This boat

had a single engine of 85 horse-power, and was about 65 feet long.

The *Pilot* was superseded in 1889 by two small ice-breakers, the *Zarja* and the *Luna*, which act as ordinary tugs during the open season, and have an horse-power of 150 each, are 98 feet long, and draw six feet of water. When working in ice these two ice-breakers work together, each vessel running alternately upon the ice, and returning. This system of ice-breaking is necessary, as the mainland shore water is so shallow that a large ice-breaker cannot be employed on this station.

16 feet aft in working trim. Her engines are of the triple expansion screw type of 950 I.H.P. As a result of experience the form of *Eisbrecher No.* 3 differs considerably from that of *Eisbrecher No.* 1.

At Copenhagen the ice in the sound is during the hard frost very dense and much under-shot. In strong winds it packs tightly, and under some climatic conditions becomes spongy and difficult to negociate.

The first ice-breaker at Copenhagen was the *Staekodder*, 150 feet long, having only 10 feet 6 inches draught. She was 800 I.H.P. which

Fig. 1.

The Ice-Breaker, "Sampo," off Hangö.

Hamburg and Copenhagen followed the lead of Cronstadt, and at Hamburg there are now several ice-breakers which have proved themselves capable of dealing with the heavy traffic in the ice between Hamburg and Cuxhaven during most of the winters that they have been at work. Though these vessels are not large, they are well designed and suitably arranged for the work they have to perform.

The first boat (*Eisbrecher No.* 1) built in 1871 is 130 feet, draws 13 feet, has 300 I.H.P., and has a spoon-shaped bow. The succeeding boats have increased in size and power, the last new one (*Eisbrecher No.* 3) being 140 feet long, with a draught of 12 feet forward and

was too little for a vessel of her dimensions to successfully negociate the ice at this station, and her propellers were too near the load line, and suffered many accidents. This vessel is now stationed at Korsoer, and in winter assists the railway ferry steamers on the Korsoer-Nyborg route.

At the present time the fine ice-breaker, *Slejpner*, belonging to the harbour authorities, controls the winter traffic in Copenhagen. She is a vessel of 2,000 I.H.P., and 1,450 tons displacement; is 161 feet 6 inches long, and her speed on trial was 12·75 knots. This vessel is fitted with compound machinery on the assumption that less damage was likely to

occur to low pressure boilers than would be the case with higher pressure owing to the constantly changing steam pressures consequent in an ice-breaker when at work. She is fitted with a lowering tube in the stern, to enable the propeller blades to be changed whilst afloat. The frames at the bow are close-spaced, and in fact the framing throughout the structure is of a strong character.

There is also another ice-breaker here, the *Bryderen*, belonging to the United Steamship Company. This vessel is 131 feet long, has great towing power, and is of immense assistance to the large fleet of steamers belonging to her owners. She is used a great deal during the winter in Danish waters, to keep the communication open for the company's steamers between the ports where they run.

The services of these ice-breakers have often to be supplemented by the Copenhagen salvage steamers, owing to the large winter traffic in the Belts and Sound, where the ordinary cargo boat is at the mercy of the ice when she gets amongst it. Before the *Slejpner* and the salvage boats were put to work considerable delay occurred to steamers passing the Belts in winter and using Copenhagen during times of hard frost. The salvage boats are strengthened to resist ice.

At Korsoer, in the south of Denmark, three ice-breakers are used during the winter to break the ice in the Storr Belt, to keep the passages open for the important railway service between Korsoer and Nyborg, and, when the ice is too heavy for the railway ferry boats to pass through; these ice-breakers transport the mails and passengers between these ports. They are the *Tyr*, the *Mjolmer*, and the *Staerkodder*, the latter was originally at Copenhagen. The *Tyr* is 138 feet long, has compound engines, and is most efficient as an ice-breaker. The *Mjolmer* is 143 feet long, has compound engines, of 500 horsepower and is an able boat amongst ice.

In the davits of these vessels are stowed what are termed "ice-boats," which are used for mail and passenger transport when the ice is too heavy for these vessels to work. These boats have runners under them, and are pulled over the ice by fishermen; the passengers walk, their luggage being in the boats, and when they come to an opening in the ice, all embark and cross the water, and resume walking on the other side. This method of travelling is very slow and fatiguing, but it was quite customary at one time, especially before the Danish State Railway in 1894 obtained a powerful ice-breaking railway ferry steamer.

There are also ice-breakers at Kiel, Riga, Rostoff, Stettin, Libau, Amsterdam, Kalmar, Stockholm and Nicolaisk, but they are all more or less vessels similar in type to the *Sampo* and *Ledokol III.*, built on the River Tyne. There are many small ice-breakers used as post boats and pilot boats in the Baltic, the German coast, and the Black Sea. At Amsterdam, the ice in the Sea Canal is kept in movement principally by small steamers, and, as it is not very thick, this arrangement answers well in ordinary winters.

Nearly all the canals in Holland, when frozen, become the principal means of communication by skating and sledging from one town or village to another.

Ice-breaking as an assistance to commerce is brought to a high state of perfection at the ports of Hangö and Helsingfors, in Finland, though the latter port is not kept open all the winter, the whole power of the Finnish ice-breakers, *Murtaja* and *Sampo* being, about January, concentrated entirely on Hangö. The latter vessel was built on the river Tyne. She has a propeller at each end, the bow engine being 1,200 I.H.P., and the stern engine 1,350 I.H.P. She is 202 feet long, and 2,000 tons displacement; has a draught of water of 18 feet, with all coal and stores on board, and her sides are angled considerably. She was put to work at the commencement of the winter of 1898, and has been most successful during her career.

The actual performance of the *Sampo* in the Gulf of Finland shews that she has a very efficient form for ice-breaking; she passes through field ice of 12 inches to 16 inches in thickness at eight knots an hour. The thickness of the drift ice she has been generally at work in, is some 8 to 10 feet, through which she can pass at from two to three knots an hour. She also breaks down larger packs without much trouble. It is found in practice with this vessel, that charging in drift ice is more effective than cutting it down with the bow propeller, as is advocated in America.

The *Martaja* and the *Sampo* proceed out into the Gulf of Finland as far as the open water in the Baltic, breaking a canal, through which they afterwards escort the cargo steamers into the harbour, the same operation being repeated when the vessels are ready to sail. In the Gulf of Finland, the harbours of Hangö and Reval are much affected by the wind, as the outer drift ice during a southerly wind makes

Hangö difficult of approach, and a westerly or northerly wind has the same effect at Reval. During gales, the ice-breakers of these parts suspend operations, as the pressure of the ice becomes so enormous, that even if the ice-breaker can force her way, the canal behind closes up almost at once, so that to the ordinary tramp steamer it becomes a problem as to whether it is safer to proceed or to come to rest in the ice, in which latter circumstance she will be drifted with the ice, or squeezed if the ice packs.

There are two ice-breakers at Gotheberg, and two at Drammen, in Norway; these vessels are well able to keep these ports open.

"charge" the ice, or the plating would be holed, and it is impossible to drive the engines, or the blades of the propeller would be knocked off. On the other hand, if the ship is allowed to rest in the ice, the sea inlets become frozen up, and the risk of being squeezed and holed is ever present.

Many German, Finnish, Norwegian and Danish steamers, comply more or less fully with these requirements, and are therefore able to give a good account of themselves in ice.

At Reval there are four ice-breakers of varying dimensions, and the efforts of these vessels are supplemented by a well-arranged system of telegraphing all ships approaching the coast. The larger ice-breaker attends to vessels to and from the harbour to the entrance of Reval Gulf, a distance of 15 miles, and occasionally goes as far as the open water beyond. The three smaller boats keep the ice broken inside the mole and harbour, and tow and move the vessels in the harbour.

FIG. 2.

THE REVAL ICE-BREAKER.

At Christiania, there is a fine ice-breaker, the *Isbjern*, built at that port. She cuts a canal down the lovely fiord from the harbour to the sea, and keeps a channel free under all the conditions of ice at this place.

Ordinary merchant steamers trading during the winter in ice, should have the plating at the bows doubled, and the side plating for some width about the waterline should be of a much heavier scantling than usual. The propeller blades should be of very strong design, and fitted to the boss to facilitate repairs; when this is done, steamers can take care of themselves to a very large extent. Without strengthening of this nature vessels dare not

The large boat is a fine vessel, but somewhat out of trim, as when she was put to work it was found that she pushed the broken ice in front of her, owing to her bow lines being too full. To meet this difficulty she is trimmed a good deal by the stern, but this prevents her having the valuable advantage of "tipping"

herself more by the stern when she sticks on or in the ice. An ice-breaker should be capable of altering her trim quickly by moving water from her forward end to the after end, or by filling up the after compartment rapidly, as should she stick forward her engines might be unable to release her.

At Odessa there are three powerful ice-breakers, the latest one, *Ledokol III.*, having been built at Walker. She is 148 feet long, 2,2co I.H.P., and has a speed of 13 knots. This vessel is well able to break the ice three feet thick and has, therefore, been most successful on her station, never having been jambed and being always able to free others in distress or fast in the ice. The ice at Odessa is principally pack ice of a broken-up description, which at times owing to wind and tide packs very tightly, and occasionally freezes together in a hard compact mass.

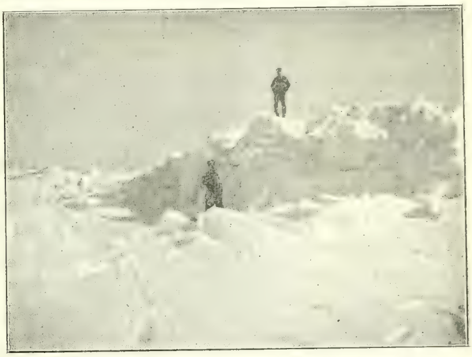
At Vladivostock, in Eastern Siberia, there is a fine ice-breaker, the *Nadeshny*, which is of vast importance and assistance to the port, as the Russian fleet stationed at Port Arthur is now able to patrol this harbour, which is the naval base, during the whole winter. The ice at Vladivostock attains a thickness in hard winters of 36 inches, but the packs only occur at the outer edges of the field ice, when the wind blows in the direction of the entrance to the harbour. The harbour is an ideal one surrounded by hills, is quite land-locked, and has a curved entrance from which the town cannot be seen.

The *Nadeshny* was built at Copenhagen, is 183 feet long, has twin screws of 2,800 I.H.P., and is fitted with powerful pumping appliances that can be used for salvage purposes. The vessel has a speed on trial of 14·2 knots in open water.

Coming now to the design of ice-breakers and vessels suitable for working in ice, they should have the bow angles and lines so arranged that when they have mounted the ice, and the ice is giving way under the vessel's weight, they must not jamb when returning to be water-borne forward, always remembering that they are advancing and should remount the ice. When the ice is broken down it should pass along below the vessel or under the field ice, otherwise it lies on the water and has a tendency to jamb the vessel sideways ; this results in the ice-breaker having to smash a larger proportion of ice than necessary, to give side clearance, thus absorbing more power, coal and time, and probably resulting in having to back and charge the ice. An ice-breaker should also be able to turn out of the channel she has cut, and the form of the bow lines has much effect on this manœuvre.

The designs of ice-breakers vary so much that there are no certain data to guide builders ; but practice has shewn that the full forward form of spoon-shaped bow is not successful in hard and packed ice, as the vessel pushes the ice in front of herself, instead of cutting and dispersing it. It should be borne in mind that ice-breakers when "charging" in heavy ice, are in collision, so to speak, during the whole time that they are at work ; this, therefore, entails much more strengthening at the bow and sides, as the ice to be dealt with becomes more formidable. The shell plating must be considerably increased in small boats, and still more so, as the vessels increase in size ; additional stringers, stronger decks, and a liberal addition to the number of bulkheads, transverse and longitudinal, as well as many pillars, become a necessity to prevent constant recurrence of repairs.

Fig. 3.



Pack Ice in Gulf of Finland.

In the days before ice-breakers came into use at Amsterdam, Stockholm, and other ports, the custom was to have from 50 to 200 or more men to liberate a vessel. These men formed two parties, making holes through the ice at a sufficient distance apart to clear the beam of the ship, then from hole to hole a groove was cut, and the ship would charge to the best of her ability to break the ice, or saws were used to cut from hole to hole, but the operation was very slow and tedious. From a fortnight to six weeks to go fifteen miles to the open water from the ports of Reval and Amsterdam, was a fair time for a vessel, with success, to clear the ice.

In arranging the accommodation in ice-breakers, it is desirable to have all this under the weather deck, for the sake of warmth and comfort, with covered-over companions forward and aft for access below. All piping should be kept under the deck, and the fire pipes should be fitted with hydrants below and above this deck. The boiler rooms must be well closed up, and consideration has to be given to the disposal of the ashes, and special arrangements have to be made inside the vessel on which the sea inlets are fitted. Steaming arrangements and circulating water should be delivered at will to the sea inlets, to warm the circulating water, and prevent ice forming in very severe frost.

Care has to be given to the lining of the cabins at the ship's sides, and it has been found that air spaces are the best non-conductors of cold. Condensation is always a difficult problem, and dried heated air pumped in lends itself better to overcoming this trouble than the ordinary system of steam heating. Ventilation has also to be carefully considered, though it is not so complex a question as that of heating.

The rudder should be arranged for easy unshipment afloat, and should be of large area and immensely strong. The moving parts of the machinery and the shafts must be extra strong and largely in excess of ordinary practice. Large surface in the stern tubes is also required to support the shafts when the blades are striking the ice and smashing it up, and the boss and blades must be of the most liberal dimensions. The vessel should be so designed that, if possible, she can be "tipped" to replace a propeller blade whilst afloat.

On the engines it is preferable to have steam reversing gear, as the "all-round" type is a very heavy tax on the engineers when the ship is ice-breaking. In fact all the controlling gear of the engines, if they are large, should be mechanically worked so as to reduce to a minimum the labour entailed by the almost continuous handling of the engines when the ship is at work.

The safety-valves should have silent blow-offs to the condenser so that at sudden stoppages, commands on deck can be given to the crew, or to another vessel alongside of which the ice-breaker may be at the moment. Noise occasioned by escaping steam is most annoying, and makes it nearly impossible to transmit orders on deck.

Most ice-breakers are fitted with large pumping arrangements for salvage purposes, as cargo steamers often get damaged in the ice and require assistance to keep afloat.

Navigating in ice, although hazardous, is most fascinating work; it is always changing, difficulties to be overcome at a moment's notice are ever present. Think of the position of an ice-master in a breaker, with say one or two steamers following in his track! Down comes the fog; no astronomical observations can be made; all lights are blotted out; he cannot take a sounding on account of the ice; if he stops, the boat behind (if the master is not on the alert) will run into him, and this in turn applies to the second following boat. Add to this, that the ice is "on the move," but its direction is not certainly known, and the snow comes to help the complex problem! Only an iron nerve and a quick decision by those in charge of the ice-breaker can meet such a position, and if the vessel is amongst rocks or shoals, and in most places these dangers to navigation are present, the difficulties are indeed increased.

Ice pressures are far reaching and serious in their results; as showing the distance they reach, one case came under my personal observation at Reval. A north-west gale had blown the drift ice at the mouth of the Gulf of Finland into Reval Bay, against the field ice at rest in the Bay, thus forming an enormous pack at the mouth of the Bay, fifteen miles from the harbour. The result of this great pressure was shown on the outside of the stone mole, or breakwater of the outer harbour, where the ice was pressed 32 feet in height, destroying a wooden pier used for steamboats; the amount of ice pressed up represented many thousands of tons in weight.

The captain or ice-master has to exercise considerable care in cutting out vessels fast in the ice, and the procedure is to pass across the bow and then the stern of the fastened vessel. Endeavour should be made to crack the ice in some direction towards the ends of the vessel, before passing her in a parallel direction, in order to obviate as far as possible all chances of crushing the steamer's sides. In passing close alongside, the ice may "up-end" between the vessels, with the result that the ships fall together, and the "drag" of the ice-breaker is sure to fetch the other vessel alongside, unless the speed of the breaker is great enough to clear the other vessel. This has actually occurred in the writer's experience in the Gulf of Finland, when a train of eight steamers were following the *Ermack* to

Cronstadt, and but for the timely assistance of the *Ermack* life would have been lost.

Another type of steamer used in the ice is the ice-breaking passenger and mail steamer. There are not many of these vessels at work, and of course they are not able to force the packs as readily as an ice-breaker can. They are fitted with every requisite for winter service, including electric projectors. As a rule they propel themselves through the ice at night as well as by day. Three vessels of this type, the *Express* and the *Abo*, running between Stockholm and Hangö, and the *Bore* running between Stockholm and Abo, keep up a steady time-table self badly. These boats run from Hull to Helsingfors, and are, therefore, ocean-going steamers.

The *Oihonna* and *Wellamo* are also handsome boats of the same class, but smaller in their dimensions.

The *Aegir* and *Linnea*, of Helsingfors, are typical cases of ice-breaking cargo steamers. They trade regularly all the winter between Hangö and Lubeck; are 172 feet long, 15 feet draught, and 500 I.H.P., and are much strengthened over the requirements of the Registration Societies, and well-arranged for winter navigation in open water and amongst ice.

Fig. 4.

Ice Pressure at Reval n 1899.

Three of the mail boats running between Kiel and Korsoer are also examples of this type and are well known to many English travellers. The latest, the *Prinz Sigismund*, is 205 feet long and has twin screws of 1,200 I.H.P.

The *Arcturus* and *Polarius*, of Helsingfors, are splendid types of these vessels. They were built in Dundee, are 281 feet long and 3,500 I.H.P. They are first-class passenger vessels, are magnificently found in all respects and have a speed in open water of 14½ knots.

I have seen the *Arcturus* make a splendid entry to Reval through the canal cut in the ice by the *Ermack*, although in passing through the great pack at the entrance of the Gulf, she had too much speed on and damaged her sides below the waterline—in fact, she squeezed her-

The *Stanley* is an ice-breaking mail boat belonging to the Canadian Government; she is occupied in running between Prince Edward's Island and Newfoundland, across the Gulf of St. Lawrence. During the winter the ice at times packs heavily from wind and tide pressure, but this vessel is well able to negotiate the packs she meets on her station. Her length is 208 feet, her beam 37 feet. She has a powerful engine, and is well found for the service, which at times is extremely arduous and hazardous.

The *Britannia*, the first steamer of the Cunard Company, in 1844 became fastened in the ice in Boston Harbour; the townspeople arranged to help to cut her out; this was accomplished by sawing and breaking the ice, and by the aid of the vessel's paddle-wheels,

she reached the open water, as the townspeople of Boston made up their minds that the vessel should keep her sailing date. The distance that the *Britannia* had to be cut out was seven miles, and at that date this was a remarkable undertaking, and meant a great deal to the mail service between England and Canada. Mr. Nelson Cameron (the owner of the print from which the slide is made) inherited it from his father, who was on board the *Britannia* at the time she was fast in the ice. He had crossed the Atlantic as a passenger over 100 times in the Cunard line, and his yarn about the Boston ice pack was the best of the very many he could tell of his experiences in the early days of Atlantic steam navigation.

The old time whalers of Dundee, and other ports, some of which are now engaged in Polar work, either on Polar expeditions or whaling, are essentially ice-breakers of a type; they are built entirely of wood, the bows sheathed with iron, and many daring deeds have been done with some of these vessels in the Polar seas.

We must not except from this class Dr. Nansen's *Fram*; she is well designed to withstand shocks and ice pressures, and this she has proved in her long endurance in Polar ice on two expeditions, having but lately returned from four years service in Davis Straits, under the command of Captain Sverdrup.

Nor must we overlook the *Discovery* of the National Antarctic Expedition now at work in the immense ice of the Southern Polar Ocean, specially built for service in the ice; and the *Scotia* of the Scottish National Expedition, known for long as the whaler *Heckla*, built of wood, having sides 24 inches thick, and nine feet of solid timber at the bow wherewith to attack the ice.

There is without doubt a large field for winter service steamers, and their number and power will probably increase in the future, especially as more information regarding ice is obtained from winter to winter, and the method of dealing with ice navigation becomes better known.

Another type of vessel for use in winter is the railway ferry ice-breaking steamer. This useful type of steamer represents many problems, and is by far the most difficult to design and arrange. Some of the vessels are of great size, and those best known to us are used by the Danish State Railways, between the islands of the Great Belt and the mainlands. The State possesses no fewer that fifteen or sixteen of these steam ferries; of these only the five largest have two lines of rails, the remainder one line, and only three have screws—two being twin screw, the remainder having paddle-wheels.

The *Zyeland*, built at Copenhagen, is 171 feet long, has a draught ot 11 feet 6 inches. Her indicated horse-power is 1,200, and she is a very useful ship. She crosses between Korsoer and Nyborg, on the main route of railway between Denmark and Germany, a ferry of about twenty miles.

Another fine railway ice-breaking steamer is the *Malmo*, built at Malmo, running across the Sound between Copenhagen and Malmo, a distance of 16 miles. She is a powerful vessel, 268 feet long. She draws 10 feet 6 inches water, and has a speed in open water of 13·25 knots. Her engines are triple expansion, she has a space on deck for eighteen railway waggons, and successfully copes with the peculiar conditions of the ice at this station.

On the main route of railway between Denmark and Sweden at Elsinore, there is a railway ferry steamer, the *Heslingborg*, built at Elsinore, and only lately put to work. She is 177 feet long, has one line of rails, and is fitted with a screw propeller at either end. The distance across is 11 miles. She has compound engines of 800 horse-power, has attained a speed, in open water, of 10·9 knots, and has to attack heavy packed ice during the winter.

The Danish State Railways are now establishing a railway ferry between Gjedser, in Denmark, and Warnemunde, in Mecklenberg; the distance across is 24 miles. There are to be four steamers on this route, two twin screw and two paddle, 285 feet long. They are to have two sets of rails, and will be able to take on four express bogie coaches of 65 feet in length. Their speed will be 14 knots an hour, and the intention is to keep up an express railway service between Germany and Denmark all the year, without the passengers having to leave the carriages, and at times during winter the ice sets heavily on the land.

Following these vessels come the famous railway ferry ice-breakers at Saratoff on the River Volga, which are used for keeping up the services of the Riazan Ouralsk Railway across this mighty river. The river is icebound for several months during the winter. The fleet consists of two steamers, one being an ice-breaker, whose duties consist of taking across the passengers, mails, and luggage. The distance across is less than a mile, and she is generally able to accomplish the journey in

twenty minutes to half-an-hour when the ice is fast.

The other steamer is a railway ferry ice-breaker, 243 feet long, 55 feet 6 inches broad. She is capable of taking twenty-four of the railway company's large goods waggons at once, the loading and unloading of which is very expeditiously carried out. She has four lines of rails, and two very powerful hydraulic lifts at the fore end of the vessel to raise the trucks from the deck to the railway level. As the Volga changes its level all the year round, and the difference of levels at this point is about 45 feet, it is necessary to introduce the hydraulic system on the boat, otherwise four large double lifts would have had to be fitted at the four railway piers, two of which are high level, and two low level. These low level piers are submerged during the period of high water which occurs in spring during the melting of the snow and ice.

The ferry steamer is assisted by the ice-breaker before referred to when the ice gets difficult to negotiate, as occasionally the canal cut in going one way is closed before the return journey is begun. These steamers are entirely fired by oil fuel, the ice-breaker going through her trials on the Tyne and steaming out to St. Petersburg under this system, which has given entire satisfaction.

As these two vessels had to pass through the system of locks on the Marinsky Canal from Lake Ladoga to the River Swer, and so to the mighty River Volga, it was necessary to build them so that they could be parted to enter the locks; the ice-breaker in halves, and the railway ferry boat into four portions. This gave rise to considerable ingenuity of design, and a large amount of work, as each half of the ice-breaker when separated had to be placed in a barge to pass through the canal system, and, of course, all the work had to be gone through again in joining them up.

These vessels were sent away from Walker Shipyard bolted together at the division bulkheads, and all in readiness for parting, which operation took place on the River Neva, some distance above St. Petersburg. All disconnecting and coupling up had to be done afloat, which rendered the task all the more complex.

Fig. 5.

Ice-Boat in loose Field Ice.

I now wish to describe the *Scotia*, a most interesting boat built at Walker, to the order of the Intercolonial Railway of Canada, for service across the Strait of Canso, between Cape Breton Island and Nova Scotia. She is a typical ice-breaker. Either end of the vessel is intended to be bow or stern at will, so that in working she does not require to turn round in entering or leaving her landings, the gangways resting on either end of the ship when lowered for loading or discharging the trains. As her ends are alike, both propelling engines are on the centre-line of the vessel, and can be coupled to each other, if so desired. The ice in which the vessel has to work is blown into the Straits from the Atlantic or the Gulf of St. Lawrence, and at times it becomes very tightly packed.

The vessel is 269 feet long, draws loaded 14 feet, and has a speed in open water of eleven knots. Her framing is exceptionally strong, and her shell-plating in way of the ice-belt is very heavy, as she has to withstand severe local shocks.

The vessel has three sets of rails of the 4 feet 8½ inch standard gauge from end to end, and is designed to carry nine Pulman or Corrridor bogie sleeping cars, 80 feet long, each weighing 52 tons unloaded. The largest bogie saloon cars in England are 67 feet long. The decks of the steamer are enormously strengthened by deep girders and pillars throughout, so that she can, when necessary, take over a locomotive or tender, which, on the Intercolonial Express of Canada, weigh 120 tons with steam up. The vessel has four boilers, and the disposition of the four funnels and the captain's bridge gave rise to considerable ingenuity. The ship is entirely concontrolled from the bridge, as the centre of the deck must be kept clear for the coaches.

In this steamer the descent of the rolling-stock on to the deck of the steamer is somewhat steep, and consequently very large buffers are provided to catch the coaches should the brakes fail, as a run into the water at the other end of the ship is not part of the Railway Company's schedule at the Canso Ferry.

As time is an all-important factor when the train is being put on board, three coaches are run on and taken off at one time, the taking off being done by a small shunting engine.

The next railway ferry ice-breaking steamers before us are the *St. Marie* and the *St. Ignace* working across the Straits of Mackinaw, between Lakes Huron and Michigan, a distance of seven miles. Both these boats are built of oak, and are sheathed with iron in way of the water-line. The *St. Marie* is 304 feet long, has 4,000 I.H.P. She has a propeller at either end, fitted with the idea that it helped her immensely to clear the landings. This vessel takes her trains on at the bow, has three lines of rails, and is, with her sister vessel, designed to work in ice up to 24 inches thick. The power of the engines of the *St. Marie* is nearly equally divided on the propellers. She commences work as soon as the ice begins to form at the setting in of the winter, and crosses in the same channel. As the ice seldom moves at Mackinaw, she has not much trouble in keeping the ferry open. She is splendidly handled, and the manner in which the trains are put on board and taken off, would be a revelation to many railway officials in this country.

Another most interesting ice-breaking railway ferry steamer is the *Transfer* of the Michigan Central Railway Company, which ferries the trains of several railways across the River Detroit, at the City of Detroit, situated between Lake St. Clair and Lake Erie. She is 280 feet long, and is the only example at the present time of a steamer having both paddle-wheels and screw engines. She is built with a spoon-shaped bow and heavy scantlings; has three lines of rails from end to end of the vessel, and can carry twenty-one bogie trucks, or twelve passenger bogie cars. Her paddles are 27 feet 6 inches diameter, and the floats are heavily protected by plating; the wheels are immensely strong, weighing 46 tons each. She steams through ice six inches thick easily at ten knots an hour, and is in many ways a remarkable vessel. One feature in her machinery is that the paddle-wheels are geared to the engines, which leaves the railway deck undisturbed by any openings for the crank shaft usually seen in a paddle steamer.

Another vessel of the same class, and owned by the same company, is the *Michigan Central*; she has paddle-wheels only, is 263 feet long, and carries a heavy freight train.

There is also at Detroit another fine railway ice-breaking ferry boat, the *Ontario*, belonging to the celebrated Canadian Pacific Railway Company; she is 297 feet long, and has large compound paddle-geared engines.

At the port of L'Arbor, at the head of Lake Michigan, there is a fine car transfer ice-breaking steamer, the *Ann Arbor*, belonging to the Toledo and Arbor Railway Company. She crosses the head of this great lake a

distance of 60 miles. The freight cars enter the vessel at the stern. She is decked over for a considerable distance from the bows, is 267 feet long, and 52 feet beam, draws 12 feet of water, and has a displacement of 2,550 tons. She is built of oak, has twin screws at the stern, and one propeller at the bow, all driven by compound horizontal engines. Her speed in open water is ten knots an hour, and at times she has very heavy packed and field ice to deal with.

The *Nederland* is an example of the usual type of large passenger screw ferry boat in use at New York to cross the harbour. In winter the ferry steamers have to pass through the ice that accumulates and moves up and down New York Harbour during times of hard frost.

The *Solano*. This magnificent ferry-boat plies across the Straits of Carquinez situated some 30 miles north from San Francisco. She is constructed of oak, is 434 feet long by 116 feet over the guards of her paddle-boxes. The trains enter from either end. She is owned by the Central Pacific Railway Company, whose trans-continental expresses are daily ferried over by this steamer.

I will now describe to you one of the finest railway ice-breaking ferry steamers afloat—the *Pére Marquette*—built by Messrs. Wheeler, of Michigan. This vessel has to cross the centre of Lake Michigan, between Ludington and Manitowoc, a distance of some 56 miles, in all weathers, and encounter open water, heavy, solid, and packed ice, and steam through strong gales and high seas. She is 350 feet long, 56 feet beam, and when fully loaded has a displacement of 4,950 tons on 12 feet 3 inch draught. She is strongly constructed, and her shell plating is very heavy. She has a splendid arrangement of cabins in the deckhouse, and every accommodation for first-class express service where the passengers may be on board all night. Her engines are twin screw compounds, 135 lbs. pressure, and 4,000 I.H.P.

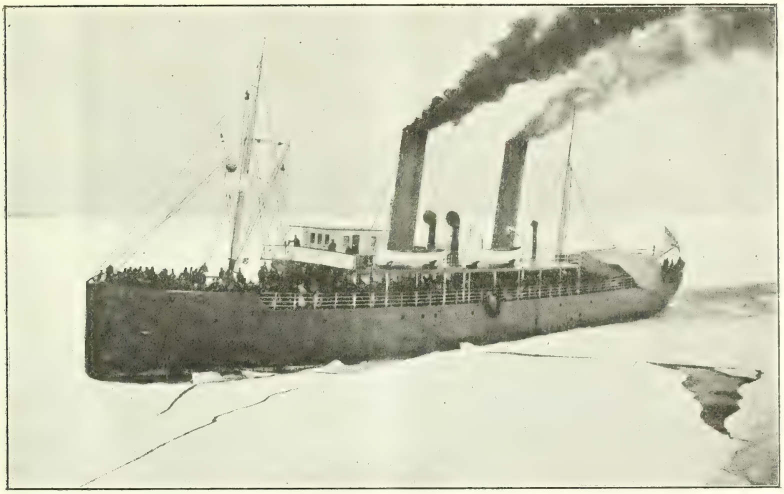
The rolling stock enters at the after end, and as there are four lines of rails, she can take on fourteen 80 feet corridor saloon cars, weighing about 56 tons each, loaded, or thirty freight cars. This steamer is truly a palatial floating hotel, and does a large amount to attract custom to the Flint and Pére Marquette Railroad Company. All the rolling stock on board is secured and blocked by mechanical means, to prevent movement in a sea-way, or when striking ice at high speeds.

On the great lakes of America, there are no fewer than fourteen car ferry routes.

From these vessels we come to the famous ice-breaker *Baikal*, on Lake Baikal, in the centre of Siberia. This splendid vessel was built to connect the eastern and western ends of the Siberian Railroad, which, as you know, makes a continuous railway from Ostend to Vladivostock, in Eastern Siberia, and Port Arthur, in Manchuria, some seven thousand miles long.

Now Lake Baikal lies N.E. to S.W., and all

FIG. 6.



THE PASSENGER ICE-BREAKER ON LAKE BAIKAL.

round the S.W. corner of the lake, the Tartar mountains impinge on the lake itself; and to make this railway round the corner of the lake meant some 500 tunnels and bridges, more or less, and as the valleys are very steep, and work can only be carried on during the open months, the engineering difficulties are apparent. Also, landing from the lake is out of the question, as the *débris* from the mountains and valleys prevent this; and as very strong gales blow without warning on this stretch of water (principally from the north-east), the lake being 500 miles long, and nearly 4,000 feet deep, very dangerous seas get up, making it impossible for vessels to lie at the south-west lake. This lasts for well over four months of every year.

Until lately, all crossing Lake Baikal in winter was by sledges over the ice, and as severe blizzards and fogs are common, it sometimes happened that an unfortunate traveller, driver, horses, and sledge would go down one of these cracks.

The distance of the ferry across the lake is 52 miles. The vessel is 290 feet long, and 4,200 tons displacement, and her draught, under ordinary working conditions, is about 19 feet.

She has three sets of triple expansion engines, one at the bow and two at the stern.

FIG. 7.

THE "ERMACK" IN THE GULF OF FINLAND.

corner. In the face of these and other difficulties, and the time that it would occupy to construct this portion of the railroad, Prince Khilkoff, the Minister of Railways and Communications in Russia, decided to order an ice-breaker to ferry the train across, and entrusted this most important problem to my firm, on account of their great experience in designing and constructing this class of vessel.

The field ice on Lake Baikal forms 36 inches deep, and owing to the gales, it packs heavily, particularly towards the Tartar coast, even grounding in some cases, and, owing to the extreme cold coming at times quite suddenly, and the ice being land-locked, it contracts and cracks, leaving dangerous crevices across the The principle of subdivision is carried out in the highest degree, and a large number of compartments would have to be pierced before she would sink. The vessel has luxurious accommodation, and a promenade deck for the use of passengers whilst they are making the passage across.

During the winters that this enormous steamer has been at work, she has proved herself to be most successful in keeping the service open under difficulties of ice-navigation that were unknown, and therefore even unthought of, during her construction. Of course, there was no knowledge of the ice as regards navigating purposes in Lake Baikal until this vessel went to work.

The hull was completely erected, marked,

taken down, and shipped inside of six months, and 2,700 tons weight, in 6,900 packages, had to be transhipped for some 1,500 miles across Siberia by boat to the place of re-erection. The boilers (of which there were fifteen) had to be kept under 20 tons in weight, for transhipment purposes, and even these great pieces were moved in sledges by the aid of hand and pony power from the railway trucks to the ship.

The vessel has three lines of rails, entered from the forward end; the centre track is very strong, to carry the locomotives, which, on this railway, weigh, loaded with tender, from 94 to 104 tons.

Her consort, the *Angara*, is a fine ice-breaker, having one screw of 1,500 I.H.P. triple expansion engines and loco boilers. These boilers were adopted so as to get over the difficulty of transhipment from St. Petersburg to Lake Baikal. She is a most successful ice-breaker, making her passages with the utmost regularity with mails and passengers.

I will conclude this paper with a reference to the *Ermack*. This magnificent piece of naval architecture is 335 feet long, 71 feet beam, and has a displacement (with coals on board) of 8,000 tons on a draught of 22 feet.

As the *Ermack* was built for Polar enterprise, as well as for ice-breaking in the Baltic, she was designed to receive the very severe blows that locally strike her when amongst the enormous ice of the Polar ocean, and ice pressures that may lift her clean out of the water, leaving her ice-borne.

Her bow engine, though successful in one year old ice, has been removed, as the shape at the bow to admit the propeller was not suited to the requirements of the Polar ice. Her speed through 24 inches of solid ice, with six to twelve inches of snow on the top of it, is nine knots an hour, and she can charge and demolish packs of ice twenty to thirty-five feet in thickness. In Polar ice the speed has to be kept at about $2\frac{1}{2}$ to $3\frac{1}{2}$ knots an hour, as one is apt to lose control of the vessel in this enormous ice, and the local shocks become very severe when she is charging about at her own "sweet will" amongst the Palæocrystic ice. She has proved herself to be of enormous use on her station on the Baltic coast of Russia, where she can negotiate any ice, and can safely bring out of danger all steamers that she goes to assist. In one short season, she rescued and assisted shipping of over two millions sterling value, and, in another winter, she salved the Russian battleship, *General Admiral Apraxine*, of £750,000 value.

With the *Ermack* in the Baltic, there is no difficulty in Russia putting to sea her fleet, which usually winters at Cronstadt, as the *Ermack* could easily guide them to open water should necessity arise; and there is nothing to prevent this vessel herself being made an armed cruiser.

DISCUSSION.

The CHAIRMAN said that the meeting would agree that they had heard a most interesting paper upon a very important subject. The author had told them how one of the greatest difficulties which had been placed by Nature in the way of human progress had at length been successfully overcome by human intelligence and skill. Navigation amongst ice had always been associated with deeds of daring and adventure, but this evening it had been brought down to the prosaic level of ordinary trade and commerce. Fortunately in this country there was not any need for using ice-breakers, but other countries were less fortunate in that respect. In Russia, for example, not only the principal mercantile ports, but the most important naval ports would be absolutely closed during winter but for the operations of ice-breakers, such as had been described that evening. The *Ermack* in the Baltic and the *Nadeshny* at Vladivostock were engaged in placing the important naval ports of Cronstadt and Vladivostock practically upon a level with open ports throughout the world during the whole of the winter instead of their being in such a state that their fleets would remain icelocked and useless for national purposes during a great part of the year. One very striking feature of the paper was the description of the very great size and power which had been reached in ice-breakers such as had been mentioned compared with the small vessels which were used at the beginning a short time ago, and are described in the early part of the paper. It must have struck every person engaged in mechanical work that extremely difficult problems of naval construction and design must be involved in the building of ice-breaking steamers. Mr. Gulston had not had time to deal with that part of the subject, but those who had listened to the paper could quite understand that such problems had required to be overcome by him and his firm; and we have seen evidence of how successfully they have been solved. First of all there was the question of the best form to be given to the vessels to enable them to make their way most effectively through thick ice with the least risk of doing damage to themselves. Then there came the great difficulty of structural strength and of giving to the hull sufficient strength for the purpose for which it was intended. There was also the difficulty of making the machinery and the propeller strong enough for their

work. The position of the bow propellers fitted in some of these vessels looked most extraordinary. On the face of it they appeared to be placed in a position in which they would suffer serious injury in attempting to force their way through ice. Perhaps Mr. Gulston would tell the meeting something more about the propellers and the effect of the ice upon them in their apparently very exposed position. He (the Chairman) supposed that while a bow propeller might be very effectual and safe in dealing with ice of moderate thickness, the question might be very different if the propeller had to deal with ice of anything like the thickness which had been mentioned in connection with the performances of the *Ermack*. The importance of ice-breakers in keeping up communication for commerce in the frozen ports of the world was inestimable. Although there was no practical use for such instruments in this country, it was most interesting to hear what had been done under the conditions where they were required. He was sure they would all agree that they owed their very hearty thanks to Mr. Gulston for giving them a paper on a subject of such great and growing practical importance.

Mr. F. J. TREWENT concurred with the Chairman in regard to their indebtedness to Mr Gulston for his very valuable paper. He believed that Mr. Gulston was the only Englishman who had had much experience of ice-breakers in Polar ice. He might, therefore, have given them a little more description of his adventures in the Arctic. The meeting would be delighted to hear a few words from him with regard to his experiences during his journeys in the *Ermack*. Mr. Gulston had stated in the paper that the bow propeller of the *Ermack* had been removed. The meeting would probably like to know the reason why such an alteration had been carried out, and whether the removal had anything to do with the propeller being in danger when the ship ran up on the ice. They would also like to have a little of Mr. Gulston's experience with regard to the extra strength which propellers in vessels of the ice-breaking class required. No doubt there were several engineers present who would like to be enlightened on that point.

Mr. GULSTON, in reply, dealt first with the Chairman's remark with regard to the strength of the machinery. They preferred shafts of about 60 per cent. of strength over Lloyd's usual requirements. With reference to the propellers it was found that in designing them it was necessary to cut them practically square across the tips, so that there was no round at all. Naturally, they were made very thick, of cast-iron, bronze, or nickel steel. Nickel steel was the best. Bronze was hardly desirable, being too soft and liable to turn up at the edge in consequence of the continual hammering across the ice. With regard to the strength of the ship it was got by bolting the frames together. The change at the bow of the *Ermack* was due to the fact that the vessel was designed to go into Polar ice as well as one-year-old ice. There was a great desire to go to the North Pole with that vessel; but in the Polar ice the bow propeller was found useless and so it was taken off. After all, the bow propeller was only used in field ice. If they went into a big pack of ice the bow propeller became choked and was unable to move. The engines were made of enormous strength, over 100 per cent. above the ordinary strength required for engines in vessels of the same size. He could not say from his practical knowledge that the bow propeller was a very useful thing, although there were people who were ready to swear by it, and would not do without it. It was certainly useful to a ship when she was backing out from a railway landing and it cleared the ice away under such circumstances. As to his personal experiences in the Polar ice, he should be very glad to give them but they would afford material enough for another paper, and would have to be illustrated by another set of slides.

A unanimous vote of thanks was passed to the author of the paper.

Miscellaneous.

THE MINES AND FORESTS OF SYRIA.

So far as is known, bitumen is the principal mineral product found in Syria, and this is mined chiefly at Hasbeya to the west of Mount Hermon, where it has been more or less continuously extracted for the last seventy years. Originally this mine belonged to the well-known old Moslem family of Shehab, on whose land it is situated, and it was worked by them spasmodically, whenever on special occasions (*e.g.*, the marriage of a son) they were in need of money, being subsequently closed when the passing need was satisfied. Bitumen is also found close to the village of Ain-et-Tineh, near Mázloula, about twenty-five miles north-north-east of Damascus. Its quality is said to be good, but it seems very doubtful, according to Consul Richards, of Damascus, whether it exists in sufficiently large quantities to make its extraction remunerative. Bitumen has also been found at Suhmur, but of so poor a quality that no attempt to extract it has been made for some years. Gum copal is found at K'feyr, near Hasbeya, for the extraction of which a certain Dr. Daoud Abu Sha'ar, of Damascus, took out a license, about three or four years ago, and succeeded in collecting some four hundredweight, of which he sent samples to be analysed in Antwerp and Hamburg, but they proved to be mostly of an

inferior description. Gypsum is found at Jerud, some thirty miles north-east of Damascus, where it is farmed out to certain natives for a yearly payment, but it is said that the introduction of British and German cement, which is being employed in Damascus more and more every year, is gradually bringing about the exclusion of this mineral from the market. Gypsum is also found at Ma'arouneh and Tel Mesken, in the Caza of Douma, to the north-east of Damascus, where it is extracted surreptitiously by the natives and smuggled into the city of Damascus. Lignite is said to exist in various parts of the vilayet, *e.g.*, in the Jebel Ralamoun, a range of hills running north-east and south-west to the immediate north-east of Damascus, in the village of Rasheya, and in Jerud, already mentioned as the site of gypsum deposits. No attempt has ever been made to extract this mineral. Iron is said to have been found at Meshgara, and in a village near Rasheya, where, it is stated, attempts have been made to smelt the ore. Phosphate of lime is known to exist in large quantities in the Balka district, at various points along the Barada Valley, and probably elsewhere in the vilayet, judging from the all-pervading limestone formation. Traces of carbonate of lime have been discovered at different points along the Hejaz Railway line. Consul Richards states that he has been informed that silver has been found at a place named Mussyaf, near Homs. It is also reported that when the country was administered by Ibrahim Pasha (of Egypt) silver was found at Ajlun. Chrome is said to have been found at Catana in the immediate neighbourhood of Damascus. Mercury exists in the Caza of Báalbek, and coal is said to exist in the Caza of Ajlun. Millstones, hewn out of basalt, are made in the villages of Habab, Eyraà and Shaàra, whence they are all brought to Damascus and exported thence to all parts of Syria, as they are of a remarkably good quality. A handsome pink marble known as "Mezzi" is found in the village of Mezzeh, on the outskirts of Damascus, and in Salhizeh, a suburb lying to the north of the city. It is highly valued locally being used for flooring in the houses of all wealthy Damascenes. A black volcanic stone known as "Hajar Aswad," which is universally used for building purposes in this city, is found at Borieda and Haja, in the Wady el Ajam district. A white stone known as "Bessimi," also used largely for building purposes, is found at Bessimeh, beyond Ain Hijeh, up the Barada valley. "Riddan," another white stone, soft and friable, also used for building purposes is found at Dummar, the first station on the line to Beirut. "Ma'aderi," a dark red stone, somewhat resembling porphyry, is found at Ma'ader, near Zibdane. It is used for paving purposes in the courtyards and rooms of well-to-do Damascenes. Consul Richards says that although the existence of the majority of the minerals mentioned in the various localities to which they are assigned, is frequently based upon hearsay, it is impossible to travel through the country with one's eyes open without realising that the mountains and hills bear every evidence of being highly metalliferous. The whole of the district is practically a *terra incognita* from a mineralogical point of view. As regards forestry in Syria, the only forests, worthy of the name, are in the Caza of Ajlun, in the neighbourhood of Koneitra, near Báalbek, and in the Cazas of Hasbeya and Kasheya. The principal trees are the prickly oak, the poplar, plane, elm, Persian lilac, willow, carob or locust bean, terebinth, wild almond, arbutus, sycamore, wild olive, beech, lime, &c. Forests in Syria, as in other parts of Turkey, are looked upon merely as sources of revenue, and yet it would be safe to affirm that no attempt whatever at re-afforestation had ever been made in order to make good the waste of centuries of charcoal burning. Damascus itself is surrounded by a remarkably dense and luxuriant belt of vegetation extending in some directions for many miles, and consisting of orchards containing most of the best known fruit trees, such as the apricot, peach, nectarine, plum, damson, olive, pomegranate, walnut, quince, mulberry, and others, while, for building purposes, the Lombardy poplar is most extensively cultivated in Syria.

ITALIAN FIGS.

The fig forms an important article of the diet of the poorer classes in Italy, in fact the total failure of the crop would be a grave national disaster, and although we cannot expect that it will ever become an article ot popular consumption in the United Kingdom, its use may be further extended than it is at the present day. Figs are susceptible of various kinds of treatment. They are perhaps the most nourishing of all fruits. They can be canned, stewed, preserved, candied, made into puddings, and used in a variety of ways which, according to Consul-General Neville-Rolfe, of Naples, seem at present unknown to British cookery. Of the fig-growing districts of the world, South Italy is one of the most important, for although the tree grows all over the country, it is only south of the Tiber that the fruit can be dried for export, the most northern district being Pozzuoli, which includes the Island of Ischia, where the cultivation of the plant is very extensive, and whence many of the best varieties grown in the United Kingdom have been imported. Going further south, we find centres of cultivation at Reggio, Bari, and Catanzaro, not to mention Sicily and the Lipari Islands, where a large business is done. As a fresh fruit it forms an important article of food, as the different varieties last through the months of June to September. Soon after this, the dried figs come in, and these are sent all over Northern Italy, and are also a large item of Italian export to France. The Italian fig is smaller and less sweet than the Smyrna variety, hence the latter has the command of the British market, and the export of Italian dried figs to the United Kingdom is a negligeable quantity. The figs grown on

the volcanic alluvium of Ischia and Pozzuoli are well flavoured, have a fine white skin, and are particularly sweet. They are besides, grown quite near the coast and this is always a beneficial condition, probably owing to the climate being damper than it is inland. The trees require very little water, in fact the growers never resort to irrigation, the natural rainfall in Italy being quite sufficient for them. Dry weather is essential at the time of the fig harvest, as the fruit should be sun dried, and when the weather is wet the fruit is either spoiled, or else artificially dried in primitive ovens, and in order to do this it is so often split up. The Italian fig is preferable to that of Spain, Portugal, or France, but in size and quality is inferior to that of Smyrna. In the important question of albuminoids, upon the presence of which the nutriment contained in the fruit depends, Italy again takes the second place, and Smyrna the first, but in fatty qualities there is no appreciable difference. The methods of packing and curing in Italy are very primitive. As the fruit is grown so largely for home consumption, the packing is done as cheaply as possible. Moreover, those figs which are exported are not very largely used as human food, but for distillation, and for the adulteration of coffee and similar substances, and consequently neatness of packing and general appearance are not studied as they deserve to be. There are three principal ways of curing in Italy, adopted promiscuously throughout the country. The usual way is to pick the fruit at daybreak, and split it up as far as the stalk. The fig, thus split, is laid in the sun. This plan has many advantages, because bad or sour fruit can be readily detected, the sun has more power, and the labour of turning the figs, which is necessary when the fruit is dried whole, is avoided. When picked and split, the fruit is laid on wicker frames, or straw mats, with the interior part upward; otherwise the contents would run to waste. They are left thus for eight or ten days, according to the weather, and are then put in baskets, and immersed for a minute in boiling water. As soon as they are dry again they are ready for packing. Another method is to split and dry the figs as above, and to insert into the pulp an almond or a piece of citron, or simply sprinkle the whole pulp with aniseed. Figs so treated are largely used in Italy, and find a certain amount of favour in the foreign markets. The third way of drying, is to dry the fruit whole. This is effected by spreading it out on mats made of cane, upon low beds of earth to ensure greater warmth, and turning the figs every day or oftener if labour is procurable. The most careful curing in the district of Naples is done at Catanzaro, whence some 800,000 lbs. of figs are exported annually. Owing to the scarcity of wood, very primitive methods of packing are used in Italy. Mats containing about 40 lbs. of fruit are made of esparto grass, and are the most common packages for all figs destined for distillation and kindred purposes. Table figs are generally exported in round drums made of thin wood, containing about 15 lbs. of fruit. For home use, the figs are generally strung on split canes or esparto straw. Two canes are thrust through the figs, till a flat mass of figs is formed, four inches wide by twenty inches long. The best of the many varieties grown in the district of Naples is the "Fico Trojano," or Trojan fig, its name clearly indicating its Asiatic origin. The interesting process of caprification of figs has been practised from time immemorial in South Italy, and some other fig-growing countries. The contest of experts on its utility may be explained by the fact that many kinds of figs do not require it, while to other kinds it is absolutely essential. The caprifig is the wild fig, and is not edible, and caprification is attained by suspending the fruit of the caprifig upon the trees of the edible fig. The fruit of the caprifig contains a special fig wasp, which hatch in the wild fig, cut their way out with their antennæ, which have teeth like a saw, and search for other caprifigs to lay their eggs in. Not finding any, they enter the edible fig blossom. The effect of this visit is the pollination of the edible fig flowers with the caprifig pollen brought by the wasps, which causes the edible fig to mature, seed, and set its fruit. Hence a supply of these wasps is essential to the fig grower, and if spring frosts or an unfavourable season has destroyed the supply of wasps, he must obtain some caprifigs from a more favoured locality to fertilise his trees. Thus when caprifigs fail in Asia Minor. shiploads are imported from Greece, and in every fig-growing country they may be purchased, in their season, in the open market.

ARTIFICIAL PUMICE STONE.

While emery is used for sharpening tools, sand for polishing stones and glass, oxide of iron for fine glass, and chalk and felt for metal ware, pumice is most frequently used for sharpening soft materials. Pumice stone is said to be unreliable both in grain and hardness. Variations have been noted even in the same piece, and this has suggested the idea of replacing it with artificial means. There is a factory at Bietigheim in Germany, in the valley of the Enz, which according to Consul General Huges of Coburg, has for some time been manufacturing an artificial pumice stone out of ground sandstone and clay, and it is interesting to note to what extent the manufacturers have tried to adapt their products to the various purposes for which they are required. There are several kinds, differing from each other in regard to hardness and grain. For example there is (1) a hard and a soft kind with coarse grain, particularly useful in the leather, waxcloth, felt and wood industries; (2) a hard and a soft kind with medium coarse grain, suited to stucco workers and sculptors, and particularly useful for polishing wood before it is painted; (3) a soft, fine grained stone for the white and dry polish of wood and for tin goods; (4) one of medium hardness with fine grain for giving the wood a surface for an oil polish; (5) a hard fine grained one for working metals and stones, es-

pecially lithographic stones, and finally pumice stones with a very fine grain. These artificial stones are used in pretty much the same way as those of volcanic origin. For giving a smooth surface to wood a dry stone is applied, but to give it a fine polish the stone is dipped in oil. For fine work no coarse grained, and for coarse work no fine grained stones are used.

Correspondence.

THE SUNFLOWER AS A PREVENTIVE OF MALARIA.

Mr. H. S. Lawrence (Poona) writes :—"In your *Journal* dated 20th March, 1903 (vol. 51, p. 418), you published an article on the Sunflower as a preventive of malaria. I requested the Secretary of Agriculture of the United States to furnish me with such information on the subject as might be available, and in particular on the legal measures which had been taken in the Mississippi valley to encourage the cultivation of Sunflowers. I have the pleasure to forward to you the accompanying extract from a letter which I received from the United States Department of Agriculture. You will observe that it fails to corroborate Mr. Gould in some of the most picturesque details of his account of the benefits of the Sunflower cultivation."

U.S.A. Department of Agriculture,
Bureau of Plant Industry,
Washington, D.C.,
September 14*th*, 1903.

DEAR SIR,

Your favour of July 6th to the Secretary of Agriculture has been referred to me for replv.

I have delayed answering your letter waiting result of some enquiries which I have set on foot in order to secure more perfect information for you.

I find that the Sunflower is not planted in this country as a preventive of malaria, the Director of the Mississsippi station advising me that he has never heard of its use in that connection. A limited quantity of the Sunflower seed is raised principally in Indiana and Ohio, the seed being largely sold as food for fowls. The acreage in cultivation in the State of Mississippi is insignificant, and there are no statistics available concerning the acreage in any of the States. So far as we are informed no oil is manufactured from the seed in this country.

(Signed) A. J. PIETERS,
Botanist in charge.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock :—

FEBRUARY 3.—"Steam Cars for Public Service." By THOMAS CLARKSON, M.I.Mech.E. LIEUT.-COL. H. C. L. HOLDEN, R.A., F.R.S., will preside.

FEBRUARY 10.—"Thermit: its application to Electrical Engineering." By CHARLES VERNON BOYS, F.R.S.

FEBRUARY 17.—"Garden Cities in their relation to Industries and Agriculture." By A. R. SENNETT.

FEBRUARY 24.—"Mahogany and other Fancy Woods available for Constructive and Decorative Purposes." By FRANK TIFFANY.

Dates to be hereafter announced :—

"Lessons to be Learnt from the Fire Brigade Appliances at the late International Fire Exhibition." By EDWIN O. SACHS.

"Artificial and other Building Stones." By L. P. FORD.

"Early Painting in Miniature." By RICHARD R. HOLMES, C.V.O.

"Mechanical Piano Players." By J. W. COWARD.

"Agricultural Education." By J. C. MEDD.

"Motor Cars for popular use." By MERVYN O'GORMAN, M.Inst.E.E.

"Physical Degeneration." By ROBERT JONES, M.D., B.Sc., F.R.C.S.

"The Rural Housing Question." By T. BRICE PHILLIPS.

"Statistics of the World's Iron and Steel Industries." By WILLIAM POLLARD DIGBY.

INDIAN SECTION.

Thursday Afternoons, at 4.30 o'clock :—

FEBRUARY 11.—"Our Commercial Relations with Afghanistan." By COLONEL SIR THOMAS HUNGERFORD HOLDICH, R.E., K.C.M.G., K.C.I.E., C.B., Member of Council. The Right Hon. SIR J. WEST RIDGEWAY, G.C.M.G., K.C.B., K.C.I.E., will preside.

MARCH 10.—"China Grass: its Past, Present, and Future." By FRANK BIRDWOOD, B.A. PROF. SIR WILLIAM RAMSAY, LL.D., F.R.S., will preside.

APRIL 28.—"Industrial Activity in Calcutta." By FREDERICK GROVER, A.M.Inst.C.E., M.I.M.E.

MAY 12.—"British-Grown Tea." By A. G. STANTON.

COLONIAL SECTION.

Tuesday afternoons, at 4.30 o'clock :—

FEBRUARY 9.—The Biology of Federation." By the Hon. SIR JOHN ALEXANDER COCKBURN, K.C.M.G. The Right Hon. JAMES BRYCE, M.P., D.C.L., LL.D., F.R.S., will preside.

[Members will please note that the date of this meeting has been changed from the 2nd to the 9th of February.]

MARCH 1.—"Nigeria." By LADY LUGARD (Miss Flora L. Shaw). The DUKE OF MARLBOROUGH, K.G., Under-Secretary of State for the Colonies, will preside.

MARCH 22.—"Cotton Growing in the British Empire." By ALFRED EMMOTT, M.P.

APRIL 12.—"The Regeneration of South Africa." By BEN. H. MORGAN.

MAY 3.—"Canada and Great Britain." By W. L. GRIFFITH.

APPLIED ART SECTION.

Tuesdays, at 4.30 or 8 o'clock :—

FEBRUARY 18 (THURSDAY). — Visit to the *Graphic* Printing-office by invitation of the Proprietors. 8 p.m. to 10.30 p.m.

MARCH 15, 4.30 p.m.—"Recent Developments in Devonshire Lace-making." By ALAN S. COLE, C.B

APRIL 19.—"The Sentiment of Decoration." By ALFRED EAST, A.R.A.

MAY 17.—"Pewter." By LASENBY LIBERTY. SIR GEORGE BIRDWOOD, K.C.I.E., C.S.I., will preside.

[*Note.*—The meeting announced for Tuesday, February 16th, will not be held.]

CANTOR LECTURES.

Monday evenings, at 8 o'clock :—

J. LEWKOWITSCH, PhD., M.A., F.I.C., "Oils and Fats—their Uses and Applications." Four Lectures.

LECTURE II.—FEBRUARY 1.—Methods of Refining — Bleaching — Demargarinating Processes—The Industry of Edible Oils and Fats—Butter Substitutes —Lard Substitutes—Chocolate Fats.

LECTURE III.—FEBRUARY 8.—Burning Oils—Paint Oils—Lubricating Oils—Blown Oils—Boiled Oils—Varnish Industry—Linoleum Industry—Vulcanised Oils—Turkey red Oils—Modern Theory of Hydrolysis of Fats.

LECTURE IV.—FEBRUARY 15.—Modern Processes of Saponification—Candle Industry—Soap Industry —Manufacture of Glycerine—Recovery of Glycerine from Soap Lyes.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, FEB. 1...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Dr. J. Lewkowitsch, "Oils and Fats—their Uses and Applications." (Lecture II.)

Royal Institution, Albemarle-street, W., 5 p.m. General Monthly Meeting.

Chemical Industry (London Section), Burlington-house, W., 8 p.m. Mr. Julian L. Baker, "A Résumé of the Report, Minutes of Evidence, and Appendices of the Royal Commission on Arsenical Poisoning."

British Architects, 9, Conduit-street, W. 8 p.m. President's Address to Students.

Camera Club, Charing-cross-road, W.C., 8¼ p.m. Mr. N. K. Cherrill, "A New Departure in Connection with Control Printing."

London Institution, Finsbury-circus, E.C., 5 p.m. Dr. J. D. McClure, "The Measurement of the Heavens."

TUESDAY, FEB. 2...Royal Institution, Albemarle-street, W., 5 p.m. Prof. L. C. Miall, "The Development of Animals." (Lecture IV.)

Civil Engineers, 25, Great George-street, S.W., 8 p.m. 1. Discussion on Mr. Alfred Edward Carey's paper, "The Sanding-up of Tidal Harbours." 2. Mr. Henry H. West, "Tonnage Laws, and the Assessment of Harbour Dues and Charges."

Pathological, 20, Hanover-square, W., 8½ p.m.

Photographic, 66, Russell-square, W.C., 8 p.m. Mr. C. W. Somerville, "Practical Demonstrations i Printing Processes" (Bromide Printing).

Zoological, 3, Hanover-square, W., 8½ p.m. 1. Mr. R. Lydekker, "The Subspecies of *Giraffa camelopardalis*." 2. Mr. Oldfield Thomas, "A Collection of Mammals from Namaqualand." 3. Mr. F. E. Beddard, "The Arteries of the Base of the Brain in certain Mammals."

Faraday Society, 82, Victoria-street, S.W., 8 p.m. 1. Mr. Sherard Cowper-Coles, "Notes on Aluminium Welding" (illustrated). 2. Mr. A. Holland, "Some Applications of the Theory of Electrolysis to the Separation of Metals from one another."

WEDNESDAY, FEB. 3...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. Thomas Clarkson, "Steam Cars for Public Service."

Geological, Burlington house, W., 8 p.m.

Sanitary Engineers, 19, Bloomsbury-square, W.C., 7 p.m. Mr. S. L. Bartholomew, "Underground Conveniences."

Royal Archæological Institution, 20, Hanover-square, W., 4 p.m. 1. Rev. J. Charles Cox, "The College of Fotheringhay," from original documents. 2. Mr. Moreton J. Walhouse, "Some Indian Weapons," with notes thereon.

Obstetrical, 20, Hanover-square, W., 8 p.m. Annual Meeting.

THURSDAY, FEB. 4...Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Linnean, Burlington-house, W., 8 p.m. 1. Prof. Sydney H. Vines, "Account of Researches in the Physiology of Yeast." 2. Mr. W. E. S. Salmon, "Further Researches on the Specialisation of Parasitism in the Erysiphaceae."

Chemical, Burlington-house, W., 8 p.m. 1. Mr. R. E. Doran, "The tautomeric character of the acidic thiocyanates." Preliminary note. 2. Messrs. R. S. Morrell and E. K. Hanson, "The resolution of $\alpha\beta$ dihydroxybutric acid into its optically active consrituents."

London Institution, Finsbury-circus, E.C., 6 p.m. Mr. Percy Fitzgerald, "Charles Dickens—His Novels and Methods."

Society for the Encouragement of Fine Arts, 6½, Suffolk-street, Pall-mall, S.W., 8 p.m. Mr. H. Beaumont, "Chutres and its Cathedral."

Royal Institution, Albemarle-street, W., 5 p.m. Mr. A. D. Hall, "Recent Research in Agriculture." (Lecture I.)

Civil and Mechanical Engineers, Caxton-hall, Westminster, S.W., 8 p.m. Mr. J. F. J. Reynolds, "General Notes on the London Traffic Problem."

Camera Club, Charing-cross-road, W.C., 8¼ p.m. Rev. T. Perkins, "Amiens and its Cathedral."

FRIDAY, FEB 5...Royal Institution, Albemarle-street, W. Weekly Meeting, 9 p.m. Mr. Alfred Austin. "The Growing Distaste for the higher kinds of Poetry."

Architectural Association, 9, Conduit-street, W., 7½ p.m. Mr. W. A. Harvey, "Cottage Homes."

Geologists' Association, University College, W.C., 7½ p.m. Mr. H. W. Monckton (President), "Some examples of the different types of Geological Formations, with special reference to recent excursions of the Association" (Estuarine, Lagoon, and Marine Deposits).

Philological, University College, W.C., 8 p.m.

Quekett Microscopical Club, 20, Hanover-square, W.C., 8 p.m.

SATURDAY, FEB. 6. Royal Institution, Albemarle-street, W., 3 p.m. Mr. C. Waldstein, "The Study of Style in Greek Sculpture." (Lecture I.)

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FRIDAY, FEBRUARY 5, 1904.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

NEXT WEEK.

MONDAY, FEBRUARY 8, 8 p.m. (Cantor Lecture.) J. LEWKOWITSCH, Ph.D., M.A., F.C.S., "Oils and Fats—their Uses and Applications." (Lecture III.)

TUESDAY, FEBRUARY 9, 4.30 p.m. (Colonial Section.) The Hon. SIR JOHN ALEXANDER COCKBURN, K.C.M.G., "The Biology of Federation."

WEDNESDAY, FEBRUARY 10, 8 p.m. (Ordinary Meeting.) CHARLES VERNON BOYS, F.R.S., "Thermit: its application to Metallurgical Engineering."

THURSDAY, FEBRUARY 11, 4.30 p.m. (Indian Section.) COLONEL SIR THOMAS HUNGERFORD HOLDICH, R.E., K.C.M.G., K.C.I.E., C.B., Member of Council, "Our Commercial Relations with Afghanistan."

Further details of the Society's meetings will be found at the end of this number.

CANTOR LECTURES.

DR. J. LEWKOWITSCH delivered the second lecture of his course on "Oils and Fats" on Monday evening, 1st inst.

The lectures will be published in the *Journal* during the summer recess.

APPLIED ART SECTION.

The Proprietors of the *Graphic* have kindly invited the Applied Art Section to visit their new printing offices in Tallis-street, Victoria-embankment, E.C., on Thursday evening, February 18, from 8 to 10.30 p.m., when the various processes in the production of an illustrated paper will be shown in operation.

As the accommodation is limited, not more than 100 cards of invitation will be issued. These cards will be issued in order of application to members until the number is exhausted. Any member who desires a ticket should apply at once.

Each ticket will admit the bearer and one friend.

No one can be admitted without a ticket.

COVERS FOR JOURNAL.

For the convenience of members wishing to bind their volumes of the *Journal*, cloth covers will be supplied, post free, for 1s. 6d. each, on application to the Secretary.

Proceedings of the Society.

EIGHTH ORDINARY MEETING.

Wednesday, February 3, 1904; LIEUT.-COLONEL H. C. L. HOLDEN, R.A., F.R.S., in the chair.

The following candidates were proposed for election as members of the Society:—

Belfond, J., Broglence-villa, Melrose-terrace, West Kensington-park, W.

Britton, H. Aaron, Plaisance Village, East Coast, Demerara, British Guiana.

Campbell, Henry Alexander, J.P., Lynford-hall, Mundford, Norfolk.

Chinnery, Walter Moresby, J.P., D.L., Hatchford-park, Cobham, Surrey.

Drummond, C. S , 23, St. Mary Axe, E.C.

Fitzhardinge, Arthur Frederic, P.O. Box 177, Cape Government Railways, Capetown, South Africa.

Fry, Miss Catherine Alethé, 27 Morpeth-mansions, Victoria-street, S.W.

Ghosh, A. Surath Kumar, F.R.A.S., 28 Elgin-avenue, W.

Goetz, Isidore. A.I.M.M,, 2 Kelfield-gardens, North Kensington, W.

Heaton, James, Ravenhead, St. Helens.

Mackenzie, Thomas, F.C.S., 4, Church-street, Inverness, N.B.

Munro, Alfred James, 16, Holford-square, W.C.

Rice, George Brackett, M.D., Clarendon-street, Boston, Mass., U.S.A.

Stott, Clement H., F.S.I., F.G.S. (Messrs. Stott and Kirkby), Harwin's Arcade, Timber-street, Pietermaritzburg, Natal, South Africa.

Tatham, Frederick S., K.C., M.L.A., J.P., 7, Timber-street, Pietermaritzburg, Natal, South Africa.

Taylor, Rev. Samuel I., B.A., 157, Fourah Bay-road, Free Town, Sierra Leone, West Africa.

White, Thomas John Ayrton, Simmer and Jach Proprietary Mines, Limited, P.O. Box 192, Germiston, Transvaal, South Africa.

The following candidates were balloted for and duly elected members of the Society :—

Allen, Greensill, Rating and Estate Office, London, Brighton, and South Coast Railway, London-bridge Terminus, S.E.

Barrow, Henry Wynford, Ashmore, Upper Redlands-road, Reading.

Brookings, Robert Somers, M.A., LL.D., 5125, Lindell-avenue, St. Louis, Missouri, U.S.A.

Budden, Hanbury A., 401, New York Life-building, Montreal, Canada.

Buxey, Framji Dinshaw, Nesbit-road, Mazagon, Bombay, India.

Chee, Lim Soo, Penang, Straits Settlements.

Chinoy, Bapoogi Ardeshir, 16, Kalbadevi-road, Bombay, India.

Chuan, Lim Kek, Penang, Straits Settlements.

Cox, Major Percy Zachariah, C.I.E., Naval and Military Club, Piccadilly, W., and British Consulate, Muscat.

Deane, Reginald, A.I.N.A., Irish Lights Office, D'Olier-street, Dublin.

De Cosson, Claude Augustin, Public Works Department, Cairo, Egypt.

Dick, Alexander Frederick Henry, 41, Lee-road, Blackheath, S.E.

Eve, George William, 18, Kensington-court-place, W.

Faraday, Charles Arthur, 149, Stapleton Hall-road, Stroud-green, N.

Ffinch, K. H. Maule, Messrs. Tomlinson and Tian Fook, 1, Raffles-place, Singapore, Straits Settlements.

Fook, Chye Tian, Messrs. Tomlinson and Tian Fook, 1, Raffles-place, Singapore, Straits Settlements.

Hong, Lim Eow, Penang, Straits Settlements.

Ikin, Benjamin R., Alsager, St. Fillans-road, Catford, S.E.

Lal, Hon. Munshi Madho, Benares, India.

McEwan, John, Carisbrooke, Enfield, Middlesex.

Mody, Naoroz H. N., 207, Piccadilly, W.

Mosbaugh, Francis R., The Huntsville and Bracebridge Tanning Company, Limited, Huntsville, Ontario, Canada.

Rosendale, Otto M., Oregonian-building, Portland, Oregon, U.S.A.

Scanlen, Arthur Dennison, Salisbury, Rhodesia, South Africa.

Scott, Hugh J., Box 204, Middleburg, Transvaal, South Africa.

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The paper read was—

STEAM CARS FOR PUBLIC SERVICE.

By Thomas Clarkson, M.I.Mech.E.

Introductory.

The necessity for superseding horse traction by mechanical power for public service is not only admitted, but is becoming increasingly urgent in view of the congested condition of the streets in large cities, and of the practical impossibility of improving and accelerating street service by present means.

Away from the cities facilities are needed to improve railway connections by the opening up of cross country routes, where in most cases there is insufficient traffic to enable even a light railway to pay, though traffic can be profitably developed providing the existing roads are utilised.

We are taught at school that "England is covered with a network of railways," but we must bear in mind that some of the meshes of the net are large, and through these large meshes many sprats are lost which cannot be economically retained by the present heavy and cumbrous network.

Here is a great opportunity for the self-propelled road vehicle, to make a lighter and more flexible network which can be spread over the large meshes between the iron roads. That this can be done without violating commercial principles seems to be no longer open to doubt, the indications being that such services will pay well in many parts already. When the blessings of improved facilities for transportation begin to bear fruit, that system can be further extended so as to include areas which at present are less promising.

One method of increasing the speed of locomotion in crowded streets, and at the same time of conveying much larger numbers of passengers from one congested area to another has, of late years, been found in the development of electric tramways. Suitable as these may be on wide main roads in the country, or in old-fashioned towns with broad streets and little traffic, the initial cost of laying down the permanent way and plant is very great, while their adoption is an impossibility in teeming business centres, partly owing to the enormous cost which the necessary widening

of the streets would involve,—a cost which even in suburban places has become almost prohibitive—and also because of the serious obstruction to the ordinary business traffic of the town, which becomes practically restricted to the narrow strips of the highway between the kerbs and the tram-lines. Cars therefore must be found that can mingle with the rest of the traffic, threading their way through the streets with ease and at any rate of speed that is desired, carrying large numbers of passengers or quantities of goods, but compact in design, and always under perfect control.

A very large reduction of the number of horses in our streets is not only possible, but desirable, on the grounds of economy, cleanliness, and humanity. The principal difficulty in realising these advantages hitherto, has been the imperfect character of the appliances put on the road, and it is clear that the severe nature of the conditions pertaining to the running of a regular public service have, in the past, not been appreciated by those engaged in constructing motor cars for this duty.

Principles of Construction.

Attempts have been made by taking an ordinary Chassis, the machinery of which is designed for a pleasure car, and fitting to it a public service body. It is not surprising, however, that these attempts have failed when we recognise that in the construction of machinery for pleasure vehicles so much of the construction is centred round the cutting down of weight to the minimum.

It is necessary to recognise at the outset that there is a great difference in the breed of a racehorse and an omnibus horse, and the same analogy holds between the machinery of a light pleasure car, and the machinery of a public service car. The pleasure car being usually for intermittent service, no serious disorganisation occurs should the service be suspended, but a public service car must be continuous in operation, and as free from interruption and interference as possible.

The construction of the pleasure and the racing car resolves itself largely into an effort to combine maximum power with minimum weight.

The public service car needs first the economical and reliable production of power, and given this, the cutting of weight becomes not only unnecessary, but positively vicious.

During the recent reliability trials conducted by the Automobile Club, it was demonstrated that the expense for fuel on the steam car, which will be described presently, reached the remarkably low record figure of ·211 of a penny per gross ton mile.

The advantage in price of using cheap paraffin fuel instead of petrol, far outweighed the difference in theoretical efficiency between the internal combination engine and the steam engine.

The most economical of the internal combustion cars was 42 per cent. more expensive in cost of fuel per gross ton mile; and, moreover, the weight of the petrol car was less than half that of the steam car. This steam car was of more substantial build than any others in the contest, and yet, notwithstanding this, its weight might have been further increased 42 per cent. without making the cost for fuel per ton mile any more than the cost for the most economical petrol car.

Consider the effect of a reasonable extra weight as an insurance against accidents. Suppose the engine and the vital parts of the car are strengthened by the judicious addition of 5 cwt. of metal. The extra cost for fuel throughout a day's run of 80 miles is only 4¼d., or ·053 of a penny per mile. Compare this with the loss of revenue and disorganisation consequent upon a car being knocked out of commission for a day. A day's revenue may be put down at from £3-£4, and in addition there is the men's wages to add as well as the loss of prestige to the service.

During the reliability trials an accident occurred owing to a light petrol car being steered into the steam car. Result:—The light petrol car was put out of commission for the rest of the day. The more substantially built steamer had scarce a scratch, and completed its day's run as if nothing had happened. The obvious moral is that "Superior metal commands respect."

In order to secure continuity of running with a mininum of stoppages, the machinery of a public service car must be designed of a most substantial and permanent character, with large safe limits in strengths and surfaces, in clearances and in capacities. Simplification must be carried through to the utmost extent, and the driver relieved from every operation which can be performed efficiency by purely mechanical means.

The driver is a very important factor in the design of the machinery of a public service car, and it is not desirable to expect that he should possess much mechanical skill. The type of man who is competent to drive a pair of omnibus

horses will generally be expected to drive a mechanically operated omnibus.

In addition to this the constructor must seriously consider to what extent he can provide against carelessness and incompetence in the driver. It may at first appear unreasonable to expect provision to be made for this in the construction, but something can be done to this end, and it does not seem possible for the designer to set himself too lofty a standard of construction. He must, therefore, seriously ask himself to what extent can the evils of neglect and incompetence be defeated. I do not pretend to say that these can be entirely vanquished, even by combining the greatest skill in production with the most careful examination and testing of the drivers, but much can be done to minimise the evil.

A general answer to this difficult proposition is found in a process of elimination, that is to say, in taking out of the hands of the driver, as far as possible, every operation requiring skill and experience, such, for example, as lubrication, which can be performed with much greater certainty and precision by the machine itself.

Owing to the improved methods of construction now available some of the old-fashioned duties of an engine driver may be entirely dispensed with. For example, the packing of stuffing boxes. This is an operation which, for its proper execution, needs a certain amount of experience, care and judgment, especially when high pressures and high temperatures are being dealt with, and a careless driver in attending to stuffing boxes would very soon injure the rods and make it impossible for the boxes to keep tight. This, however, is an operation which has now been removed from the duties of the driver, improved mechanical construction having provided a solution of the difficulty.

In general, the designer must work for cutting out adjustments whenever possible, in order to avoid imperfect adjustment. This principle is applicable both to bearings, which instead of being made in halves and adjustable, are now largely made solid and without adjustment, but of such liberal proportions and excellent material and lubrication, that adjustment only becomes necessary at very long intervals after many thousands of miles, and may then be done properly and inexpensively by a mechanic. The adjustment of valves and operative parts is also to be eliminated as far as possible. I do not suggest that all adjustment may be eliminated, but where an adjustment cannot be eliminated, it should be arranged in the most accessible manner possible. This is a thing well within the power of the constructor to arrange, and by making the adjustment easy, increase the chances that it will be made properly. If, in order to make an adjustment, the driver has to make himself in a mess, to lie on his back, or work in an uncomfortable position, at parts difficult of access, those parts will surely suffer for want of adjustment. Let all parts, therefore, needing adjustment, be, if possible, in full daylight, and in such a position that the work can be done quickly and comfortably without trouble or mess. We may then, but not otherwise, reasonably expect that the parts will be kept in condition.

So much with respect to the general principles of construction of the machinery for public service cars.

Details of Construction.

Coming now to the details of construction. As already intimated, each of the details must be of the most permanent and substantial construction, and let me say at once that only the best in material, design, and workmanship is good enough.

As the strains brought to bear on the machinery are often very severe, and far beyond their normal load, the factor of safety must be ample in order to ensure that a considerable overload does not produce any permanent result, or the first time a car gets into trouble its character will be injured for life.

Another specially important consideration in the design of the machinery for public service cars is to reduce as far as possible the amount of time which it is necessary for the car to receive, not only when in commission, but also in the garage, that is, in cleaning and preparing for commission. It is therefore a *sine quâ non* that, as far as possible, every bit of machinery shall be enclosed within a dust proof and mud proof oil-retaining case, which, at the same time, obviates the necessity for the cleaning of the machinery, for to do this thoroughly would occupy a good deal of time every night in the garage, and there would be a great certainty of its not being done in the most thorough manner.

I now beg to invite your attention to some details of construction on the steam car with which I am most familiar, namely, the "Chelmsford," some of the vital parts of which are before you.

In a steam car there is no necessity for a change speed gear and its attendant complication, the whole of the change of speed being done by the regulation of the supply of steam to the engine.

The machinery of a steam car comprises the engine, differential and transmission gear and pumps. The design of the "Chelmsford" set of machinery has been carried out in order to embody all these essential parts in one complete mechanism, which can be applied to, or, if necessary, removed from a car as a complete unit; the advantage of this arrangement is that should the engine ever suffer serious injury, it would be preferable to remove it completely from the car for repair, at once substituting a stand-by engine in order to put the car again in commission while its engine is being overhauled.

Another advantage of making an engine, differential gear, and pumps, for the driving mechanism in one unit, is that the arrangement for the lubrication of every bearing can be greatly simplified, one system of force pump distribution being then applicable, to supply in a positive manner the lubricant to every bearing; the enclosing case being designed so that the surplus oil from all the bearings drains back into a common well or reservoir from which it is filtered and again pumped to the bearings.

The arrangement for ensuring the feeding of oil to every one of the bearings is familiar to many of you, and may be described as pumping the oil into a circular box, from which there are a number of outlets leading to the bearings. A rotary valve operated by the engine switches each one of the pipes in turn into direct connection with the lubricating force pump, and thus, by feeding the oil service pipes seriatim, prevents the possibility of stoppage in supply to any bearing, which would certainly result sooner or later if some of the service pipes were in parallel. This arrangement has been found to answer admirably in practice, and has the great advantage of requiring no attention whatever from the driver; it lubricates each bearing in a regular and thorough manner, conducive alike to increased mechanical efficiency and an increase in the life of the mechanism.

A steam engine embodying the latest mechanical practice is, admittedly, the most positive and reliable of any engine, and there is no reason why the engine should ever make its existence on the car manifest, except by the satisfactory performance of its appointed work. Given automatic lubrication and entire freedom from the necesity of packing stuffing boxes on piston rods and valve rods, and the engine will run for many thousands of miles without any further attention than, once a month, supplying a little more oil to the lubricating reservoirs, and changing the pump rings.

The bearings of the engine and transmission gear are perfectly plain, and are of hardened steel, the working surfaces being ground to the highest possible degree of accuracy.

The engine is arranged horizontally, with the valves beneath the cylinders. This arrangement in the design relieves the driver of the necessity for opening and closing the drain cocks at starting, the water of condensation automatically escaping out of the exhaust.

The crank shaft is provided with a steel spur wheel of liberal proportions, which drives directly on to the differential gear with the ratio of 1 to 2. The pumps are driven directly off the differential shaft, and the advantage is thus secured of running the pumps at a reduced speed from that of the engine. At the same time this arrangement enables the reduction of speed between the engine and the road wheels to be accomplished comfortably in two stages.

This constitutes practically the whole of the mechanism, the other vital part of the car comprising the arrangement for the generation of steam, which includes the boiler, burner, and superheater.

The type of boiler which has been adopted, after experience with many forms, is the plain, vertical, cylindrical, multitubular, the outer shell being constructed of two steel plates hydraulically pressed so as to form a tube plate and half the cylindrical shell in one piece. By this arrangement both parts of the shell are of the same size, which is conducive to excellence of manufacture, and there is only one seam in the whole of the boiler shell, this being in a convenient position and entirely removed from contact with the flame of the burner. The fire tubes are straight, and are expanded into a tube plate at each end, the protecting edges being afterwards beaded over so that each tube forms a stay. There is only one hole in the centre of the upper part of the boiler, and into this screws a steel header or connecting piece with independent branches leading to the twin safety valves and the throttle valve. The working pressure is 250 lbs. per square inch, and the

test pressure is 450 lbs. of steam and 800 lbs. hydraulic pressure.

The boiler is carried on a circular frame, which is bolted on to the main frame of the Chassis. Within this circular frame a superheating coil is fitted, the length of tube in the coil being sufficient to raise the temperature of the steam to about 750° Fahr.

The burner is contained in a steel box of conical form, the interior of which is lined with asbestos and sheathed with nickel, in order to prevent the disintegration of the asbestos by vibration on the road. The burner case is bolted up to the lower side of the aforementioned circular frame, and the flame is distributed over all the tube plate.

This arrangement enables either the burner or boiler to be removod or exchanged without interfering with the other part. The burner is fitted with an automatic controlling device, operated by steam pressure, and an indicator is provided in front of the driver by which he can see at a glance the size of the flame, whether the burner is in full commission, or whether it is shut down to a low flame.

The control of the feed-water into the boiler can be automatically governed by a thermostat, but in some cases a simple foot valve is used, and no difficulty has been experienced with this arrangement in practice.

In front of the driver is a wheel controlling the supply of steam, and this and the steering wheel give him control completely over the running of the car.

There is a foot lever operating an outer band brake on each driving wheel, and a hand lever operates an internal expanding break on each driving wheel. The hand lever may be locked.

The exhaust steam from the engine is conveyed to the condenser, which is located in the fore part of the car. This, while preventing the appearance of visible vapour, increases the distance capacity on a single charge of water, and largely obviates the necessity for replenishing, the time occupied in which has to be deducted from the running or earning time.

Actual Results in Use.

It is interesting to note the results of the running of this set of machinery, and as a public service was started at the beginning of last November, and maintained over two months without intermission with one car, it is easy to get at the running costs, there being no difficulty in locating the charges to each individual car, as would be the case if more than one car were in commission.

The results are shown in the following Table:—

Cost per Mile for Running Car No. 1.

Wages and fuel only. (Two drivers, one conductor.) From November 2nd, 1903, *to January 2nd,* 1904. *Licensed to carry* 14 *passengers.*

Week ending	Pence per mile.	Number of Passengers carried.	Oil in galls.	Miles.
Nov. 9 ..	6·03*	2,787	115	305
,, 16 ..	5·84*	2,523	112	345
,, 23 ..	4·09	2,169	95	360
,, 30 ..	4·16	1,929	90	345
Dec. 7 ..	3·94	1,931	90	350
,, 14 ..	4·30	1,960	95	342
,, 21 ..	3·97	2,148	93	355
,, 28 ..	4·91†	2,286	85	280
Jan. 4 ..	3·67‡	2,328	83	350
	9 ÷ 40·91	20,061	858	3,032

4·54d. average per mile during nine weeks.

* Wages of one extra mechanic included in 1st and 2nd week.

† Holiday week.

‡ Dry roads.

Average cost per mile during 6 normal weeks	4·02 of a penny.
Total distance run	3,032 miles.
Paraffin used	858 gallons.
,, ,, at 5d. per gallon ..	1·42d. per mile.
Lubricating oil used, 10 gallons	0·16d. ,, ,,
Water consumption—	
Fairly level route	0·15 gals. per mile.
Hilly route	0·24 ,, ,,

Cost of Parts Renewed during the same period.

	£	s.	d.
Burner renewals	1	0	0
Gauge glasses		4	0
Brakes	3	10	0
Chains		3	0
Packing		2	0
Repairs or renewals to boiler	Nil.		
Repairs or renewals to engine	Nil.		
Repairs or renewals to rubber tyres ..	Nil.		
Total.......	4	19	0

Cost of renewals, per mile = 0·39 of a penny.

Tyres.

After 3,500 miles, the solid rubber tyres had reduced in diameter ½-inch, and appeared in good condition. A total reduction of three inches seems permissible. This would indicate that the life of a set of tyres may reach 20,000 miles.

Estimating on a probable life of 15,000 miles, and taking the value of a set of tyres at £60 (sixty pounds), the cost of tyres per mile = 0·96 of a penny.

Comparative Summary of Receipts and Costs.

	£	s.	d.		Per mile.
20,061 Fares at 2d.	167	3	6	Wages ..	2·55d.
				Fuel	1·42d.
Divide by 3·032 mile.				Lubricant	0·16d.
				Renewals	0 39d.
				Tyres ..	0·96d.
Receipts per mile average 13·2·d.					5·48d.

essential, and the pit should preferably be equipped with connections for attaching the cable of a portable electric inspection lamp. The bottom of the pit should have a good slope towards a sump or well, and on each slde of the pit runners may be fitted to enable a light bogey to be run under the cars for the convenient handling and removal of the burner box or engine, the parts being lowered from the car and run out on the bogey beneath the level of the floor.

The replenishing of the water and fuel must be done through large bore pipes, so that a car may be replenished in the shortest time possible. Certainly, with proper arrangements, this need not exceed two minutes, and within the writer's knowledge, it has been done in 45 seconds. It is necessary to have an efficient arrangement for measuring accurately the quantity of fuel supplied to each car, and a good clock is necessary to ensure regularity in the starting of the cars.

Fublic Service Car.

Garage Equipment.

One of the important adjuncts to the satisfactory running of a public service of motor cars is the garage equipment and organisation. This must be so arranged as to enable a car to be handled, whether for cleaning or replenishing, inspection, renewing, or adjustment, with the greatest facility and expedition, for it must be always remembered that when a car is in the garage it is not earning, but on the contrary is an expense.

An inspection pit, over which a large number of cars may be run, is absolutely essential, and the pit should preferably be equipped with connections for attaching the cable of a portable electric inspection lamp.

Each car ought to have a separate lock-up cupboard for the care of cleaning materials, stores, and spares, and clear instructions

exhibited in the garage as to the daily duties of both the drivers and cleaners. This will help to keep them up to the mark, and makes for efficiency.

A resident garage engineer should be held responsible for the cars being inspected each morning before they are allowed on the road, and he should have the assistance of experienced mechanics for effecting an overhaul. A rigid system of inspection is necessary for the cars before being sent out each morning, and at the end of the day's work, and a diary kept of any work done and any parts renewed on each car.

The entrance to the garage and the exit should be carefully arranged to simplify manœuvring and getting over the pit, and it will be best if the cars first pass through the washing area before proceeding to their allotted berths, each one having access to the pit if necessary, and able to be removed from the garage without necessarily disturbing the rest.

Drivers.

One of the most important matters, especially with a large public service, is the provision of an adequate supply of reliable drivers.

It will be a prime necessity to select for drivers, active, quick-witted, sober, and well conducted men, train them thoroughly in the use of the car, test their powers of steering and stopping and handling the car, before putting them on the road, and insist on their making themselves acquainted with the mechanism, so as to know when anything appears to be amiss, and correct it at once. Handy men, of the blue-jacket type, or who would be smart drivers of omnibuses or hansoms, are the kind of recruits wanted.

Although it is not necessary for the driver of one of these cars to be a trained mechanic, it is necessary that he should be in possession of his senses, and a careful test ought to be made of his fitness to be entrusted with the responsibility of driving a public service car.

First of all his eyesight should be tested, both for accuracy and colour blindness.

Second, his quickness of action should be tested by a communication through the senses both of sight and hearing.

In addition there might be a nerve test for his steadiness under sudden and unexpected disturbance or interference.

It is believed that much may be effected in this direction by purely mechanical methods, and the enhanced value of the would-be driver is thereby increased to a far greater extent than is represented by the expense of the trial.

It is therefore suggested that a school for drivers is desirable, in order that they may be made familiar with the general construction of the car, and at the same time furnish an opportunity of selecting the best men, and eliminating the wasters.

Having selected the driver and fairly started him on his duties, it is suggested that his remuneration be a fixed wage, plus a monthly bonus, the award of which depends upon keeping the car regularly in commission.

It has also been suggested that a special bonus be paid to those drivers who, by caring for the tyres, avoiding stones when possible, and the too sudden application of brakes, have the power to considerably reduce the cost of the tyre maintenance. The writer is of opinion that these suggestions embody a sound commercial principle, which it is worth the while of all who are interested to take note of.

DISCUSSION.

Colonel R. E. Crompton, C.B., said he had hardly any destructive criticisms to offer on the paper. The author had struggled through immense difficulties, and had performed two great achievements by making a car which was good enough to work for public service and by making it work with paraffin. It was far too much the habit of the public, which saw a large number of pleasure vehicles running in the streets, to think that motor cars were in a very advanced stage. Undoubtedly the motor car driven by petrol was a very perfect pleasure vehicle to those who could afford time and money, but with the notable exception of Mr. Burford's cars very few cars had been put into public service. Cars had been put on the streets, but had been withdrawn, one of the principal reasons for which was that there were dangers and risks attaching to petrol when it was used in very large quantities, in addition to its high price. It was well known, as the author said, that theoretically a steam engine used more fuel than the internal combustion engine, yet, on account of being able to use very cheap fuel compared with petrol, Mr. Clarkson succeeded in producing a result in the reliability trials which, for equal weights, was 40 per cent. better than the best petrol motor, a very fine achievement. Mr. Clarkson had shown the steam engineers of England the astonishing result that a comparatively small-sized steam engine had beaten the internal combustion engine on its own ground. He had done that by a combination of many beautiful features, each of which taken by itself would

have been creditable, but taken together in one car, the observer was apt to undervalue them because they were so many and all good. It was a marvellous result to have been able to run 1,019 miles without experiencing the trouble of the blocking of the burner. The difficulty connected with burning paraffin was that carbonaceous deposits were formed in the narrow passages; and it showed the forethought and care the author had devoted to the subject that he had been able to secure the success he had done. Mr. Clarkson had also embodied in the engine some most beautiful features; he had thoroughly case-hardened and ground the parts; he had substituted for the very annoying packing in the glands, which had always to be renewed, the very beautiful system of solid floating phosphor-bronze bushes, an interchangeable system of pumps, and a system of lubrication, each of which was worthy of great merit. But he thought the old and well tried type of boiler, which the author had used after making experiments with more modern and better types, was not the best. He (Colonel Crompton) had had considerable experience of the modern types of boilers, and both the White and Miesse flash boilers were far more likely to give satisfaction, to cost little in upkeep, to be perfectly safe in use, and never give trouble with bad water, as was the case with the multitubular and very expensive type of boiler the author had adopted. He thought the excellence of Mr. Clarkson's performance in the reliability trials reflected the greatest credit on English engineering generally. More originality had been shown in the design of the cars described, than in the whole of the cars shown in the recent French exhibition, about which so much had been said. That was a great feather in the cap of England, and Mr. Clarkson should be sincerely congratulated on it.

Mr. E. Shrapnell Smith said the first point which appealed to him was the reference to the question of steam omnibuses versus electric traction. He agreed with Mr. Clarkson that a great many authorities in this country had become so devoted to the fetish of electric traction, that they had gone ahead more rapidly in electric traction than was justifiable. He did not refer so much to large centres of population, such as London and other large cities, but there were many towns in England with a population of 60,000 or 600,000 which borrowed £200,000 to spend on trams, when they could, by means of the motor omnibus, carry out the whole of the service required for about one-sixth of the capital expenditure, greatly to the relief of the rates. He hoped, through the paper and the discussion, it would be brought to the notice of the different authorities which were contemplating going in for systems of electric traction that there might be just cause for investigation in that direction. Mr. Clarkson had referred to the failure of the vehicles that had been put on the road. A great deal of the failure was due to the cause that the light Chassis, designed for pleasure purposes, had been overloaded. The notoriety the failures received had given a distinct set back to the use of self-propelled public service vehicles, which was, to a great extent, undeserved. The author had referred at some length to the question of drivers. He thought one feature in comparing the driving of a public service vehicle propelled by an internal combustion engine as compared with the steam engine was, that in the latter the engine was never out of gear, but with a petrol motor, the driver, in climbing a hill, had to step down three or four times, and even the man who drove a pleasure car very often misjudged the momentum of the car, and damaged his car in consequence. Mr. Clarkson had referred to over-driving. He thought the makers would have to produce machines which must comply with all the ordinary business exigencies of public service, even if they were over-driven; they must be made strong enough to be over-driven. Mr. Clarkson's car looked as if it would stand a lot of over-driving without any serious result. He had been amused at the moral the author of the paper drew when a little butterfly petrol car happened to knock up against his car. Probably if Mr. Clarkson's car had bumped into a big petrol car the result would have been different. The system of lubrication adopted was one which must appeal to everyone—absolute automaticity in lubrication was a great gain. As the author pointed out, it was not the actual cost of the replacement or repair which was the important factor, but the loss of earning power. The machine was tied up for a day or two, and no income was made from it. Mr. Clarkson had given a sketch of what he thought was a proper arrangement for a garage, but no provision was made for it in his estimate of cost. There was a very good margin between the estimated income per mile of 13·2d. and the cost of working, 5·48d., to cover the supervision, management, and general charges. Personally, he did not think that unless, in a public passenger service, one could see one's way to a certain income of about 10d. or 11d. a car mile it would pay, taking all charges into account. He was quite in agreement with Mr. Clarkson, when he said it was desirable to have spare parts in case anything broke; if there was trouble with the boiler or the engine, it it was very handy to lift them out of the frame and drop in new ones; but he would like to know what was the weight of the engine as shown. In looking at the photographs he had been struck with the fact that, having regard to recent design, Mr. Clarkson had preserved a considerable amount of curvature of the springs. He wished to ask whether the author had any reason to consider them superior to the flatter springs which were now more generally used. His own experience was that where there was a big curvature, there was a good deal of frictional play between the plates, and that the flatter springs of the railway type were the better. With regard to the

exhaust valves being underneath the cylinder, the author mentioned that when the driver had been standing with a car and then started, the water which had accumulated ran out. But there was a further advantage in having the exhaust valves on the under side of the engine. He had seen many designs of steam engines where the exhaust pipe came away above the level of the cylinders, and there was gradual condensation in the pipe, which ran back into the cylinder, and, on several occasions, this had blown out the ends of the cylinder. In regard to the boiler tubes, were they screwed at either end, or were they merely expanded in? It was cheerful to hear that tyres were only going to cost 1d. a mile, but the estimate that they would run for 20,000 miles was based on the statement that they had run 3,500 miles, and had only been reduced ½ an inch in diameter. He had endeavoured to get makers to guarantee their tyres for 5,000 miles, with not very encouraging results. As Mr. Clarkson was using a tyre which was giving better results than he had been able to obtain hitherto, he would like to ask whether the makers of the tyres gave a guarantee that they would run a certain distance. The proposal for the establishment of a school for training drivers was a good one, but it would have to be at his own works; and if he was prepared to train them there it would be a great assistance in getting the cars adopted and successfully used on the road. The secret of making a car a success was to pay the driver on the bonus system; and the principle should be adopted that if the car was broken down and in the shed, the man was also broken down to a considerable extent in his wages.

Sir EVAN JAMES, K.C.I.E., referred to the excellence of the engines of the author's cars, which, on being taken to pieces after running 3,000 or 4,000 miles, were found to be as good as new, owing to the system of lubrication adopted. There was no doubt a necessity for good drivers, as the mechanism contained in the cars should not be placed in charge of an ignorant person, and no doubt arrangements would be made to send out competent people in charge of the cars to avoid break-downs.

Mr. EDWIN N. HENWOOD thought the figure of £60, which the author had given as the cost of a set of tyres, was very much below the actual cost; he was informed that the price was £120. It should also be considered, from an engineering point of view, whether it was not far better to put the resilient material in the place where the minimum quantity would give the maximum effect. It was very cruel to put all the resilient material—rubber—on the outside of the wheel, where it was ground away, and where it very often caused serious injury; and there was also the drawback that the brake could not be applied with any great power without militating against the endurance of the tyre; whereas if one-third of the quantity of rubber which was now put on the tyre was put into the hub of the wheel, five times as much resilient power would be obtained from the rubber as was now got by using it as a tyre, and it would probably last for ten, or more, years without renewal.

Mr. GODFREY BREWER said the two principal problems which had arisen in connection with cars, were the boilers and the wheels. The style of boiler which Mr. Clarkson had adopted, had, in the past, proved most unsatisfactory. In the table giving the cost of renewals, the repairs to the boiler were stated as "nil," but he noticed from the paper that the vehicle had only been at work two months and a week. He would very much like to know what the result would have been at the end of six months, as he had found that, at the end of six months, boilers fitted with partially submerged tubes usually required renewing. Also, in the design of boiler used, there was no possible means of cleaning the boiler internally, except by washing it out with a hose pipe; it was impossible to remove the scale from the tubes; in fact, the boiler had to be worked until it required renewal, or a new boiler was put in its place. Until somebody designed a boiler which had totally submerged tubes, or produced a device which would recover a far greater proportion of the condensed water than was at present the case, he did not think there was much chance of the boiler used by Mr. Clarkson giving successful results. As far as wheels were concerned, his experience was with wheels not fitted with rubber tyres. Of course, rubber tyres considerably saved the wheels, but the cost of the tyres had to be put against that. He thought it was rather doubtful whether it would pay to continue to use rubber tyres. He quite agreed with Mr. Smith's remark that because a tyre ran 3,000 miles, and only wore half an inch, there was no reason to hope that the tyres would continue to wear at that rate. As far as the upkeep of tyres was concerned, he found that very few makers of tyres would guarantee them, but he had heard of one maker who quoted a price of 1½d. per mile for maintaining the tyres.

Mr. WALTER WHITE thought that for cars for public service work steam was the only practical system. The need for change-speed gear was a great drawback to the internal combustion engine. He thought Mr. Clarkson had been guilty of one inconsistency. He had warned his audience not to overload the cars, and yet he himself used one uniform style of Chassis, but sometimes with a light body and light load, and at other times with a heavy body and heavy load.

Mr. J. H. KNIGHT asked what was the mean speed at which the public service vehicles ran when travelling on the road.

Mr. ARTHUR NASH wished to add his testimony to the thorough efficiency of the author's car. At Torquay last December a wave about 40 feet high broke right over the front and thundered on the car, the water in the road being six or eight inches deep; but the burner was not extinguished, nor did the car give any trouble.

The CHAIRMAN thought the subject was of the utmost importance, and one in which the public had a very great interest at the present time. The desire for more rapid transport had been increasing ever since transport was invented, and at the present time the rapidity of increase was naturally very much greater than it was in former days, due first of all to the public knowing what could be done, to a certain extent; and, secondly, to the great increase there had been in engineering facilities in the last thirty years, not only in regard to the eapabilities of the manufacturers, but also the reduction in cost. Our ancestors, not very long ago, were quite content with stage coaches, and though during the latter days of those vehicles a few fervid attempts at road locomotion were made, unfortunately they were smothered by restrictive legislation. Those who had studied the actual machinery used then for road locomotion were astonished to see how perfect it was, and how comparatively little could be done nowadays to improve it. The next thing which expedited transport was the railway, but railways at the commencement were few and far between. The next system of transport that came into vogue was the bicycle, which annihilated distance for those who chose to exert themselves. After that came the electric tram. Many present did not altogether appreciate the value of electric traction; electric traction usurped the whole of the road and possessed the great disadvantage to the other traffic that if the other traffic got on the rails it was sometimes difficult to get off, and a great many accidents had been caused to bicycles and motor cars through the direct influence of the tram-rails. The motor car was more or less of a private vehicle, and although it had done a good deal towards popularising rapid transit, the first makers and exploiters had followed their inclinations by selling them as private vehicles rather than turning their attention to commercial vehicles, as Mr. Clarkson had done. There was no doubt whatever that the proper thing to do now-a-days was to direct attention to vehicles for the use of the public generally, and not for the use of selfish owners. In regard to the advantages of steam cars, he thought everyone must admit that in large cities the problem of the transport of the citizens had not been successfully dealt with. In London everything was done by the police to regulate the traffic, and yet it was impossible to be five minutes on one of the busiest thoroughfares before one saw what a hopeless problem it was. Mechanically propelled vehicles would obviate some of the disdavantages of horse propelled ones; they would take less room, be under more control, and travel faster, all of which conditions would lead to improvement. The increasing of the pace would allow the road to be clearer, because if the traffic travelled faster, naturally it covered the distance in a less time, and therefore there were fewer vehicles on the road for the same number of passengers in the time. He wished to place on record his admiration and appreciation of Mr. Clarkson's untiring energy and ability as exemplified in his steam-car. He had watched the author's work for the last six or eight years, and it all tended to the one end of producing a vehicle which should work as nearly as possible automatically, and in that object he (the Chairman) thought Mr. Clarkson had succeeded. He recently rode with the author on one of his cars to Chelmsford, and if he had not known there was a steam engine under the car and a boiler in front of him he could not have told what was propelling the car; apparently all Mr. Clarkson did was to steer; everything else was done automatically. He had also seen Mr. Clarkson's works, and thoroughly endorsed Colonel Crompton's remarks in regard to the accurate workmanship and the design of all details. Several speakers had thrown doubt upon public service vehicles succeeding on account of their not earning sufficient money. That was a point on which much could not be said at the present time; it would work itself out, and a great deal more would be known about it in the near future. The subject of tyres was a very difficult one, in connection with it, the only thing he could say was, that if india rubber tyres were to be used, it was probable they would have to be solid, because solid tyres were more reliable, and had more lasting qualities than pneumatic tyres.

Mr. CLARKSON, in reply to Col. Crompton, said there was a good deal to be said in favour of the semi-flash type of boiler, but there were serious drawbacks to its use for public service, the chief one being that it had very little reserve power; steam was quickly got up but also quickly lost. He was not going to say what was to be the ultimate type of boiler, but having experimented with many types for so long, he came to the conclusion that he must select one which gave the most uniformly reliable results in the hands of unskilled engineers. Some 4,000 or 5,000 boilers of the type he used had been put into the hands of the public by an American firm, and no one had ever heard of one of the boilers exploding. Their great drawback was that they might be burned, but there was no reason why they should be; in fact, he told the Torquay people that if a man burned his boiler he should be fined £1, and a case had never occurred. Mr. Smith went into the question of petrol *versus* steam. He did not intend to argue one way or the other. The field was large enough for anything that was good, and it was impossible to decide by any process of discussion what was going to be the ultimate type of motor. He wished for nothing better than to see both types

run level on the same conditions, and the final verdict must rest with the public. The approximate weight of the whole of the engine was about 300 lbs. In that connection one must recognise not merely the weight but the power it was able to produce. In the internal combustion engine the maximum power represented by the cylinder capacity and the speed was reached, and nothing could be done beyond it; there was not, as in the case of a steam generator, the means of adding 50 per cent if necessary to the working pressure to get one out of a hole. The steam engine had the further advantage of being double acting, *i.e.*, each cylinder had four times the number of impulses of a cylinder of the same dimensions on the internal combustion principle, and the drive consequently was more uniform. With reference to the curvature of the springs, he agreed that flatter springs were successfully used on railway work, but he did not think that was quite comparable to road work. On railway work, running on the edge of a rail, the amplitude, or range of movement of the springs, was comparatively small, and they could never hope to have a road surface as good as that. It had been proved already that it was necessary to provide for a very large amplitude, otherwise when one had a very heavy load over a bad piece of road the springs were tested and, if there was not enough clearance, something was bound to break. Mr. Smith asked if the tubes were screwed together: they were expanded by a roller and beaded over, each tube acting, therefore, as a stay. With reference to a guarantee of the tyres, the makers of the tyres he was using were not prepared to give a guarantee, for the reason that they did not know how they were to be used. He did not know whether it was safe to deduce by a rule of three sum what the life of a tyre would be from 4,000 miles running wearing off half an inch in diameter. Certainly there was no indication of that disintegration which had been in the past the great source of cost in rubber tyres. He considered that the large broad-faced single tyre was not a practical thing. One must necessarily have sufficient rubber to bear a heavy weight, in fact, the quantity of rubber must be proportional to the weight if it was to have any reasonable chance of life; but he thought the twin tyre, and possibly the triple tyre, had furnished a solution to the tyre difficulty. A tyre could be made which was never pushed to the disintegrating limit, and which, therefore, would go on wearing down, and might give some reasonable prospect of approximating to the figure he had suggested—15,000 miles, which he considered reasonable. In discussing the matter recently with the engineer of one of the leading railway companies, he was told that they expected to exceed 10,000 miles with their tyres, and were considering the question of the granting of a bonus to the drivers of $\frac{1}{4}$d. up to $\frac{1}{2}$d. for every mile got out of the tyres beyond 10,000. There were firms manufacturing tyres which were prepared to keep people supplied with tyres at a certain sum per thousand miles; he believed for a public service car it was something under £100 per 10,000 miles; but according to his experience it was not necessary to expend so much money. In reply to Mr. Henwood, £60 per set of tyres was not the cost but the selling price; he would be prepared to supply that gentleman with as many sets as he wanted at £60 a set. He did not think practical results had shown that the use of rubber, not on the rim but in the hub, was the correct principle; it was not correct to shut up a cylinder of rubber in a box and not allow for compression or eccentric movement. Mr. Henwood stated that there was only one-fifth the quantity of rubber, and, therefore, it was much cheaper to get the effect instead of having the rubber all over the tyre; but it must not be forgotten that one-fifth was punched five times as hard, and unless provision was made for the lateral expansion of the rubber, it was not a bit of use putting it in a box and expecting that it would be springy. It had been suggested by Mr. Brewer, that there was no chance of the boiler proving durable until there was an efficient condensing arrangement, which recovered practically the whole of the water condensed. He (the author) submitted that they had an efficient condenser. On the sixty-five miles run, of which the Chairman had spoken, on very heavy roads the water consumption was about equal to the oil consumption for fuel. In the ordinary way the water consumption would be about twelve times the oil consumption; they had brought it down to about one-twelfth, and that being the case, they were practically able to run the boiler with distilled water all the time. Mr. Brewer also expected that in six months the boilers would have to be re-tubed. He (Mr. Clarkson) did not expect they would have to be re-tubed oftener than once in two years. Mr. White pointed out that he was falling into the old error of putting a large body on to a light pleasure Chassis. That was not quite correct. It was quite correct to say he was using the same sized engine on the larger cars as was used on the lighter pleasure cars, but the conditions were favourable and reasonable, and the strength of the frame, springs, and axles was modified accordingly. On a light pleasure car people wanted to travel fast; on a large public service car they did not want to travel so fast. The same engine could therefore be geared to suit both of these conditions. The running speed of the public service cars might be taken at 10 or 1[illegible] miles an hour.

On the motion of the CHAIRMAN, a vote of thanks was accorded to Mr Clarkson.

Obituary.

RT. HON. SIR EDWARD BRADDON, K.C.M.G.—Sir Edward Braddon, who died in Tasmania on Tuesday, 2nd inst., was a member of the Society of Arts until shortly after his return to Australia

891. He was a member of the Council in the years 892–93 and 1893–94. He read four papers before he Society, viz., "Recent Development of Tasmanian ndustries and Prosperity," in March, 1891; "Australasia; its Progress and Resources," in April, 1892; 'Russia as a Field for Trusts," in February, 1893; nd "Australasia as a Field for Anglo-Indian Coloniation" in April of the same year. For the first two e received silver medals. Sir Edward was born on he 11th June, 1829, the son of Mr. Henry Braddon, olicitor, of Skisdone-lodge, Cornwall. In 1847 he vent to India to join a mercantile house in Calcutta, ut subsequently accepted a Government appointment s Assistant Commissioner in Santhalia, and served vith Sir George Yule's Volunteer force in the Indian Mutiny. He remained in India in various official apacities until 1878, when he retired on a pension nd went to Tasmania. He was elected to the House of Assembly, and after becoming a prominent leader of the Opposition he was called upon in 1887 to orm an Administration. He was Agent-General for Tasmania in London from 1888 to 1894. On his eturn to Tasmania in that year he became Premier nd leader of the House of Assembly, which offices he etained until 1899. He was author of "Life in ndia," 1892, and "Thirty Years of Shikar" in 1895.

GEORGE JORDAN FIRMIN.—Mr. G. Firmin, a nember of the Society of very old standing, since e was elected in 1861, died at Philadelphia on the 21st December last. Mr. Firmin was born at Colchester in 1825, and for many years carried on the usiness of a manufacturing chemist in London. Between the years 1851 and 1862 he took out no less han four patents for improvements in the manuacture of citric and tartaric acid, potash oxalate, &c. n 1871 he went to America, and settled in Philadelphia, where he was well known as a manufacturing hemist. Besides his work in connection with the nanufacture of citric and tartaric acid, he was, in partnership with Dr. T. A. D. Forster, the inventor of a process for the amalgamation of gold and silver re. He was one of the guarantors of the London Exhibition of 1851, and took a great interest in the Centennial Exhibition at Philadelphia in 1876.

General Notes.

NAPHTHA IN EASTERN ASIA.—Eastern Asia s one of the richest mineral fuel regions in heworld. The area of all the paying coal beds n Europe, comprises only 22,760 square miles, an area equal to that of one of the Russian provinces—the Kazan Province. The area of coal beds in Eastern Asia, though not yet estimated, is considered incalculable. Besides immense coal beds, Eastern Asia possesses wealthy underground naphtha lakes that will soon, it is expected, become the foundation of a great industry. Naphtha springs are found everywhere in China, in Manchuria, in the Ussuri district, in Japan, and on Sakholin Island. The latter island not only possesses very rich coal mines, but also large naphtha lakes. A chemical engineer, after having examined the coal beds and naphtha wells in Texas and Pennsylvania, made an investigation of the naphtha springs on Sakholin Island, and on his return to Baku, declared that all he had seen in the United States was nothing in comparison to what he found on Sakholin. The naphtha springs near the River Nootova, on Sakhalin, excel those of Baku in every way, according to the latest report ot the United States Commercial Agent at Vladivostock. Seven underground naphtha lakes are there, the area of the largest one being over 75,000 square yards. Notwithstanding the increased output of the Japanese naphtha, Japan must still import the foreign article. In 1900, the country imported more than 60 million gallons; and in 1901, 61 million gallons. The export from Japan is inconsiderable, so that the Japanese naphtha does not threaten to become a rival to Sakhalin naphtha. On the contrary, Japan promises to become a good market for the Sakhalin naphtha. The development of the oil industry on Sakhalin Island, will help the new navigation on the Amur, and in the Far East generally.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock:—

FEBRUARY 10.—"Thermit: its application to Electrical Engineering." By CHARLES VERNON BOYS, F.R.S.

FEBRUARY 17.—"Garden Cities in their relation to Industries and Agriculture." By A. R. SENNETT.

FEBRUARY 24.—"Mahogany and other Fancy Woods available for Constructive and Decorative Purposes." By FRANK TIFFANY.

INDIAN SECTION.

Thursday Afternoons, at 4.30 o'clock:—

FEBRUARY 11.—"Our Commercial Relations with Afghanistan." By COLONEL SIR THOMAS HUNGERFORD HOLDICH, R.E., K.C.M.G., K.C.I.E., C.B., Member of Council. The Right Hon. SIR J. WEST RIDGEWAY, G.C.M.G., K.C.B., K.C.I.E., will preside.

COLONIAL SECTION.

Tuesday afternoons, at 4.30 o'clock:—

FEBRUARY 9.—"The Biology of Federation." By the Hon. SIR JOHN ALEXANDER COCKBURN, K.C.M.G. The Right Hon. JAMES BRYCE, M.P., D.C.L., LL.D., F.R.S., will preside.

APPLIED ART SECTION.

Tuesdays, at 4.30 or 8 o'clock:—

FEBRUARY 18 (THURSDAY).—Visit to the *Graphic* Printing-office by invitation of the Proprietors. 8 p.m. to 10.30 p.m.

CANTOR LECTURES.

Monday evenings, at 8 o'clock :—

J. LEWKOWITSCH, PhD., M.A., F.I.C., "Oils and Fats—their Uses and Applications." Four Lectures.

LECTURE III.—FEBRUARY 8.—Burning Oils—Paint Oils—Lubricating Oils—Blown Oils—Boiled Oils—Varnish Industry—Linoleum Industry—Vulcanised Oils—Turkey red Oils—Modern Theory of Hydrolysis of Fats.

LECTURE IV.—FEBRUARY 15.—Modern Processes of Saponification—Candle Industry—Soap Industry—Manufacture of Glycerine—Recovery of Glycerine from Soap Lyes.

CHARLES T. JACOBI, "Modern Book Printing." Two Lectures.

LECTURE I.—FEBRUARY 22.—*Printing Types.*—Some account of those used by the early and subsequent Printers—Founts specially designed for the private Presses of the present day — Some good Types that may be obtained in the open Market, well adapted for the different classes of Book Printing—The choice of a suitable Type.

LECTURE II.—FEBRUARY 29.—The Details of Composition—The Formation of the Page—Margins—Paper—Ink—Presswork—Title Pages—Some conclusions.

BERTRAM BLOUNT, F.I.C., "Recent Advances in Electro-Chemistry." Three Lectures. March 7, 14, 21.

The following course will be delivered on Monday afternoons, at 4.30 o'clock :—

PROF. R. LANGTON DOUGLAS, M.A,, "The Majolica and Glazed Earthenware of Tuscany." Three Lectures.

April 25, May 2, 9.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, FEB. 8...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Dr. J. Lewkowitsch, "Oils and Fats—their Uses and Applications." (Lecture III.)

United Service Institution, Whitehall, S.W., 3 p.m. Dr. Miller Maguire, "The New Pacific from a Strategic Point of View."

Mechanical Engineers, Storey's-gate, Westminster, S.W., 8 p.m. Mr. W. H. Merrett, "The Work of the Alloys Research Committee."

Surveyors, 12, Great George-street, S.W., 8 p.m. Discussion on Mr. Ralph Nevill's paper, "The Garden City Scheme and First Garden City, Limited."

Geographical, University of London, Burlington-gardens, W., 8½ p.m.

Camera Club, Charing-cross-road, W.C., 8¼ p.m. Mr. L. Wallace, "The Great Dominion."

Medical, 11, Chandos-street, W., 8½ p.m.

Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p.m. Miss Hilda Boord, "Notes on the Volcanic Phenomena of New Zealand."

London Institution, Finsbury-circus, E.C., 5 p.m. Prof. Grenville Cole, "The Fringe of the Balkans."

TUESDAY, FEB. 9...SOCIETY OF ARTS, John-street, Adelphi, W.C., 4½ p.m. (Colonial Section.) Hon. Sir John Alexander Cockburn, "The Biology of Federation."

Asiatic, 22, Albemarle-street, W., 3 p.m.

Royal Institution, Albemarle-street, W., 5 p.m. Prof. L. C. Miall, "The Development of Animals." (Lecture V.)

Medical and Chirurgical, 20, Hanover-square, W. 8½ p.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Mr. Henry H. West, "Tonnage Laws, and the Assessment of Harbour Dues and Charges."

Photographic, 66, Russell-square, W.C., 8 p.m. Annual General Meeting.

Anthropological, 3, Hanover-square, W., 8½ p.m.

Colonial Institution, Whitehall-rooms, Whitehall-place, S.W., 8 p.m. Mr. John Ferguson, "Ceylon from 1896 to 1903."

Pharmaceutical, 17, Bloomsbury-square, W.C., 8 p.m.

WEDNESDAY, FEB. 10...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. Charles Vernon Boys, "Thermit: Its Application to Metallurgical Engineering."

Biblical Archæology, 37, Great Russell-street, W.C., 4½ p.m.

Dante Society, 22, Albemarle street, W., 8½ p.m. Mr. Maurice Hewlett, "Dante and the Traveller."

Sanitary Institute, 74a, Margaret-street, W., 8 p.m. Discussion on "Road Sanitation."

Royal Literary Fund, 7, Adelphi-terrace, W.C., 3 p.m.

THURSDAY, FEB. 11...SOCIETY OF ARTS, John-street, Adelphi, W.C., 4½ p.m. (Indian Section.) Col. Sir Thomas H. Holdich, "Our Commercial Relations with Afghanistan."

Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

London Institution, Finsbury-circus, E.C., 6 p.m. Mr. Percy Fitzgerald, "Charles Dickens—his Novels and Methods." (Part II.)

Royal Institution, Albemarle-street, W., 5 p.m. Mr. A. D. Hall, "Recent Research in Agriculture." (Lecture II.)

Electrical Engineers, 25, Great George-street, S.W., 8 p.m. Prof. R. M. Walmsley, "Transatlantic Engineering Schools and Engineering."

Mathematical, 22, Albemarle-street, W., 5½ p.m.

Camera Club, Charing-cross-road, W.C., 8¼ p.m. Mr. G. A. T. Middleton, "Perspective from an Architect's standpoint."

FRIDAY, FEB. 12...Royal Institution, Albemarle-street, W., 9 p.m. The Dean of Westminster, "Westminster Abbey in the Early part of the Seventeenth Century."

Civil Engineers, 25, Great George-street, S.W., 8 p.m. (Students' Meeting.) Mr. T. S. Nash, "The Electricity and Destructor Station at Plumstead."

Astronomical, Burlington-house, W., 5 p.m. Annual Meeting.

Clinical, 20, Hanover-square, W., 8½ p.m.

Physical, at the Royal College of Science, Exhibition-road, South Kensington, S.W., 8 p.m. Address by the President, Dr. R. T. Glazebrook,

SATURDAY, FEB. 13...Botanic, Inner Circle, Regent's-park, N.W., 3¾ p.m.

Royal Institution, Albemarle-street, W., 3 p.m. Dr. C. Waldstein, "Culture and Sculpture." (Lecture II.)

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FRIDAY, FEBRUARY 12, 1904.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

NEXT WEEK.

MONDAY, FEBRUARY 15, 8 p.m. (Cantor Lecture.) J. LEWKOWITSCH, Ph.D., M.A., F.C.S., "Oils and Fats—their Uses and Applications." (Lecture IV.)

WEDNESDAY, FEBRUARY 17, 8 p.m. (Ordinary Meeting.) A. R. SENNETT, "Garden Cities in their relation to Industries and Agriculture."

THURSDAY, FEBRUARY 18, 8 p.m. (Applied Art Section.) Visit to the *Graphic* Printing Office, by invitation of the Proprietors. Admission by ticket only (see below).

Further details of the Society's meetings will be found at the end of this number.

CANTOR LECTURES.

DR. J. LEWKOWITSCH delivered the third lecture of his course on "Oils and Fats" on Monday evening, 8th inst.

The lectures will be published in the *Journal* during the summer recess.

COLONIAL SECTION.

Tuesday afternoon, February 9th, 1904; The Right Hon. JAMES BRYCE, M.P., D.C.L., LL.D., followed by SIR WESTBY PERCEVAL, K.C.M.G., in the chair. The paper read was "The Biology of Federation," by the Hon. SIR JOHN ALEXANDER COCKBURN, K.C.M.G.

The paper and report of the discussion will be published in a future number of the *Journal.*

INDIAN SECTION.

Thursday afternoon, February 11, 1904; The Rt. Hon. Sir J. WEST RIDGEWAY, G.C.M.G., K.C.B., K.C.I.E., in the chair. The paper read was "Our Commercial Relations with Afghanistan," by COLONEL SIR THOMAS HUNGERFORD HOLDICH, R.E., K.C.M.G., K.C.I.E., C.B., Member of Council.

The paper and report of the discussion will be published in a future number of the *Journal.*

APPLIED ART SECTION.

The Proprietors of the *Graphic* have kindly invited the Applied Art Section to visit their new printing offices in Tallis-street, Victoria-embankment, E.C., on Thursday evening, February 18, from 8 to 10.30 p.m., when the various processes in the production of an illustrated paper will be shown in operation.

As the accommodation is limited, not more than 100 cards of invitation will be issued. These cards will be issued in order of application to members until the number is exhausted.

Each ticket will admit the bearer and one friend.

No one can be admitted without a ticket.

CANTOR LECTURES ON "THE MINING OF NON-METALLIC MINERALS."

Mr. Bennett H. Brough's Cantor Lectures on "The Mining of Non-Metallic Minerals" have been reprinted from the *Journal*, and the pamphlet (price 1s.) can be obtained on application to the Secretary, Society of Arts, John Street, Adelphi, London, W.C. A full list of the Cantor Lectures, which have been published separately, and are still on sale, can be obtained on application to the Secretary.

COVERS FOR JOURNAL.

For the convenience of members wishing to bind their volumes of the *Journal*, cloth covers will be supplied, post free, for 1s. 6d. each, on application to the Secretary.

Proceedings of the Society.

APPLIED ART SECTION.

Tuesday evening, January 19, 1904; LEWIS FOREMAN DAY, Vice-President of the Society, in the chair.

The paper read was—

CELTIC ORNAMENT.

By GEORGE COFFEY.

It will, I think, be conceded that ornament is at present in general debased, and is in a confused state. The conscious efforts made by craft societies and schools of design, to raise the quality of artistic work, sufficiently declares this to be so. But while this is true, there are an increasing number of individuals producing admirable work of the highest technical finish, and of original if sometimes eccentric design. There is, however, no living style, or expression of our time, which can be named as a period in the sense in which we speak of the distinctive periods of ornament.

Perhaps I should make a partial exception in favour of what is called *L'Art Nouveau.* But such modern movements do not appear to have that element of permanence—a central relation of style to architecture—which marks an epoch. On the contrary, there is a sense of feverishness, a constant forcing of the pace in the chase of novelty, so that modern ornament comes to be ranked as fashion rather than style.

Then there is the constant cheapening of original work by commercial copies, till what comes from the hands of the artist rare and beautiful straightway is made common and tedious. Thus the artist hardly dares to give his most delicate thoughts form, lest he should find them shouted in the streets the next day. Perhaps this must be so, since the sceptre of the arts has passed from architecture. The absence of representative style in architecture, and consequent decline of monumental art, has led to the loosening of control in ornament; and in an age of advertisement and display, has produced that overloading of ornament so evident on all sides. The feeling for proportion and power of decoration has been lost.

Bad painting, bad music, does not last. But bad architecture unfortunately does last. And so our insurance offices and banks, with their advertising fronts of cut stone, are with us for generations.

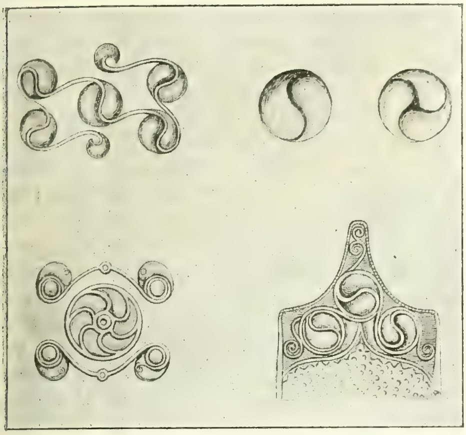
The result of the absence of a living style is necessarily a confusion of styles. At the present moment buildings in Romanesque, Gothic, and Renaissance may be seen rising up side by side in any considerable town, and an architect is supposed to be able to supply a design in any style that may be asked for. In earlier times, when art was still an expression of national life, this was not so; from the temple or cathedral to the humblest dwelling style ruled. The craftsman worked in a living style, was, as it were, part of it. Art expressed life in the sense that it was natural, unconscious, like a language the style of the period was the common speech, was the only style. So much was this the case that a building begun in the style of one period was continued in the style of the next. This fact that the same building may exhibit two, three, or more styles, so incomprehensible to us, and impossible in modern work, is explained when we realise that in the periods in which art was a natural expression, it was unconscious. The builder or craftsman spoke the thing he knew and that only. Hence the disregard for work that was not of their time. Think you the villagers who built the 16th-17th century cottages, set themselves to build beautiful cottages? They built the only cottages they knew, and they were beautiful because they did not know what was ugly. These same people would probably have thought the modern villa residence much finer.

The bane of decorative art in the present day is its self-consciousness, and the end is reached when it comes to be advertised as a commodity. Formerly you bought the furniture you wanted, and the designs and work were good. Now you have your choice between furniture and art furniture. You now buy your art as something added, something over and above the article.

It is not surprising then, that the power of decoration has been lost. Now objects appear to exist for the purpose of showing off the cleverness of the ornament. The ornament no longer appeals to the faculty for joy, but to the purse and the intellect. Everything seems to be done with effort. It is no longer the caress of the hand or enrichment of imagination, but painful invention. The designer speaks consciously and with difficulty a language that does not come freely to the tongue.

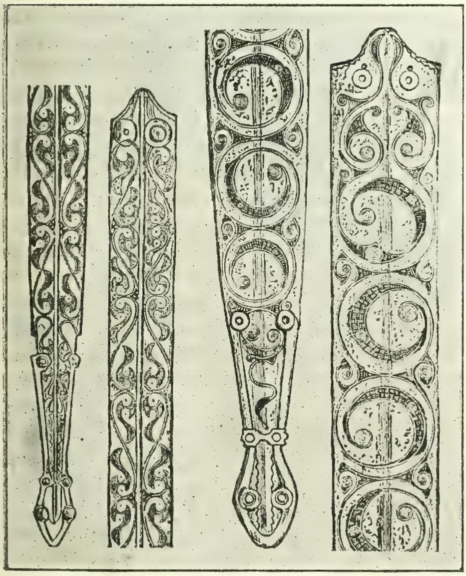
This brings me to the immediate purpose of my lecture. As far as I can form a judgment on the subject, designing does not begin until the forms come as freely to the end of the pencil as speech to the lips. It is one of the secrets of the mastery of the Japanese. Since tradition no longer controls ornament, and the designer is no longer, as it were, a part of a living style, we must rely on education. We must replace tradition and style by education.

Fig. 1.



Examples of the S-curve and Comma-shaped Spaces from La Tène, Switzerland, and Aylesford, Kent.

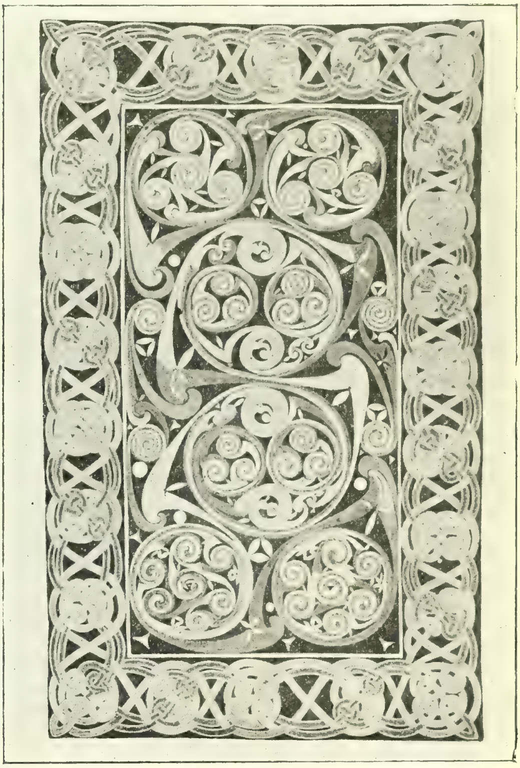
Fig. 2.



Sword Sheaths from Lisnacrogher, co. Antrim.

Now while much time is spent in our schools of design in training the eye and hand, too little attention has, I think, been given to the training of the mind. For this purpose the historical method appears to be the only one now possible. It does not so much matter what particular style of ornament is taken in the first instance. But the student should, I think, be kept to one style until it has been mastered like a language, that is, until he can think in it. Only thus, I believe, can the power of decoration be developed. It may be doubted whether our museums and schools of design in which we find everywhere a babel of styles, have been, from this point of view, wholly beneficial.

Fig. 3.



Ornamental page from the Book of Durrow: Colours—red, yellow, green, black and white.

We cannot hope to see again a national style. Art in the future must, I think, be individual, not an expression of national life but of the individual, and in that sense a

luxury. Hence education must aim at excellence and not averages. The average is of no importance, the individual artist is everything.

The following series of slides have been selected with a view of illustrating the line of thought I have endeavoured to put before you.

Mr. Coffey then showed a number of examples of late Celtic ornament, chiefly in metal work, selected from specimens from the Danube, Rhine, and north-east of France districts, also from England, Scotland, and Ireland.

He first threw on the screen a map showing the distribution of Celtic sites in the period preceding that which he proposed to deal with, extending across Europe from the Danube to the west coast. About 400 B.C. the Celts burst the barrier of the Alps and overran Italy. In 390 B.C. they took and burnt Rome. Later they plundered Delphi, and in the 3rd century B.C. passed into Asia Minor, where they founded the colony of Galatia which still retained their name. In contact with the Mediterranean civilizations, the meander and anthemion patterns of Greece and Italy had influenced their ornament. The characteristic S-turn, a simplification of the running spiral, dividing the circle into two comma-shaped spaces, appeared early in the Danube area. Uniting with the meander and anthemion it determined the distinctive form of Celtic scroll work. The restraint of Greek ornament was not acceptable to the Celts. Their search for energy and life in the line led to the absorption of the Greek elements of the pattern, and in the west, especially in Britain and Ireland, a stylisation of the forms was effected in which the Greek elements were so completely transformed as to be no longer apparent.

Examples were shown from Hungary, Switzerland, France and Britain, in which the essential unity of the Celtic scroll patterns was demonstrated, ranging from the 4th to 1st century B.C. (Fig. 1.) The examples on the left side of the figure were from a small Celtic cemetery at Aylesford, Kent, and that at the bottom on the other side, part of a sword-sheath from a Celtic site at La Tène, on the Lake of Neuchâtel, Switzerland. The figures above the latter illustrate the bossing-up in metal of this characteristic Celtic form, and show how three or more segments can be introduced, leading to the Celtic whorl. We thus saw that a long way from the starting point we found the forms fully developed, and taking the beautiful swinging curves depicted. An interesting point was then made. The S-curve developed as a style in the Celtic lands went out completely under Roman influence. After the Roman occupation of Gaul that style ceased, and did not re-appear in art until we came to Flamboyant Gothic. It seemed that yet again in France, that land of the Celtic mind, in what is called *l'Art Nouveau*, we found in our own day the same feeling for the curve prevailing.

Another series was then shown, what is known as the Trumpet pattern, so called from the trumpet shape of the leading element. It was traced to the filling in of the turn back and turn forward of the scrolls of the anthemion pattern. Examples of ornaments were shown from Celtic graves in Germany, in which the development of the form could be traced. Numerous examples were then shown of combined scroll and Trumpet patterns, chiefly in metal, from England, Scotland, and Ireland. The illustrations included a beautiful boss of a shield found in the Thames, the original of which was in the British Museum; a very fine collar found in Roxburghshire, in the National Museum at Edinburgh; a tankard found in Wales, now in the Liverpool Museum; the work on the metal handle of the tankard was exceptionally fine, and strongly resembled late Gothic. It had, indeed, been supposed, for a long time, to be Gothic, but was now recognised as really Celtic, of a pre-Christian style in these Islands. Some bronze discs from Ireland were then shown, one of which was unfinished, and showed the process of manufacture. A bronze conical-shaped object, in the Petrie collection, Dublin, was also shown. It had been supposed to be a portion of a radiated crown, and had been considered by some authorities the most exquisite relic of the period known. Some sword sheaths from the Co. Antrim were much admired. The engraved ornament on them recalled the earlier form of the style (Fig. 2). Some carvings in stone recently discovered in Ireland were also shown. These latter were the first specimens known in stone of early style. The use of enamel was a feature of the later period of the Celtic style, especially in the West of France, Britain, and Ireland. In the earlier period, from about 400 to 200 B.C., settings of coral were frequent in France, and a few examples had been found in Britain. The coral had been traded to Gaul from the Mediterranean. After about 200 B.C., coral was replaced by enamel, and a remarkable development of that art was found in these islands. Slides were exhibited showing examples of Celtic enamel work from pre-Christian times. The art had continued without break into Christian times, and many beautiful examples were known in which enamels formed an important feature, such as the Ardagh chalice, which might be dated about 900 A.D. The survival of the pre-Christian scroll and Trumpet patterns in the early Christian art of Britain and Ireland was then dealt with. In all ornament there is a tendency, when a form has been developed, and, as we may say, determined, for it to be in time set free and become an element in itself. We saw this in the case of the so called trumpet ends of the pattern. The small pointed oval, which resembled the trumpet mouth, was bossed up in metal and became more and more important, as the style became more conventionalised, until it might be said to be, in its later stages, the signature of the style. In the Christian period it was a conspicuous feature. In the illuminated manu-

scripts it was effectively used as a sprinkling, though always organically worked into the pattern. Fig. 3, a page from the Book of Durrow, in the library of Trinity College, Dublin, dated about 700 A.D., was a good example in point. Examples were shown on the screen from the Gospels of Lindisfarne, the books of Durrow and Kells, the Ardagh Chalice (Fig. 4), &c. By the year 1,000 A.D. the older scroll patterns had become rare, and were finally completely displaced by interlaced patterns.

the design. He did not know whether the author quite clearly showed how, in the Christian period, closely-coiled spirals of the Bronze Age were combined with long sweeping curves of the Late-Celtic period. During the long Celtic period, from 400 B.C. to the time of the departure of the Romans, one got nothing but long sweeping curves; but after that, with Christian ornament, one found closely-coiled spirals which were characteristic of the Bronze Age. So there seemed to be a com-

Fig. 4.

Ornament on Under Side of Base of the Ardagh Chalice.

DISCUSSION.

Mr. Romilly Allen said he was sure everybody present had listened with the greatest possible interest to the extremely lucid explanation of the evolution of Celtic ornament given by the author. Everyone who had studied the subject of those so-called Late-Celtic designs had necessarily been puzzled to understand their origin, and the meaning of those long sweeping curves, curved almond-shaped projections, and so on. They must have originated either from direct copies of nature, or have been the result of successive copies of designs. The number of slides shown by Mr. Coffey put them into such definite order, that one was able to trace from the original spiral and the long sweeping curve, the whole evolution of bination of the two styles. With regard to the Trawsfynydd tankard of which a slide of the handle was exhibited, that was one of the most curious examples of similarity between the Late-Celtic flamboyant ornament and the Flamboyant ornament of the Gothic period. He was given credit by the author for having discovered that, but he must disclaim the honour, as it belonged to Dr. Arthur Evans, who found that it was a Late-Celtic specimen. Previously to that it was described as Gothic. It was now in the Mayer Museum at Liverpool, and was one of the most beautiful and perfect specimens of the kind. The woodwork of the tankard was absolutely perfect, and the bronze covering also, with its handles. He thought it was

probably one of the tankards out of which the ancient Britains drank their mead. With regard to the question of the bearing of Celtic art on art generally, he noticed that in Regent-street, there were exhibited specimens of "Cymric Art," and all sorts of names appeared to have been applied to what seemed to be a bastard attempt at curvilinear design. Anyone who compared the meaningless meanderings of the so-called Cymric jewellery, with the easily flowing curves of Late-Celtic art, would see how hollow those designs were, and how essential it was that one design should be studied thoroughly and absorbed into the mind, so that that particular style could be appreciated. He hoped the matter would be taken up by the museums and art institutions generally.

Mr. H. H. Cunynghame, C.B., said he did not know that he could add anything to what had been already said; but one or two remarks occurred to his mind in listening to the very interesting paper. He had been for many years an observer of the technical schools, at all events of London, and had been himself a student of art design. He would say that the principle of the learning of one language at a time was perfectly right. Otherwise he thought confusion occurred in the mind of students, similar to that which would be produced in the man who tried all at once to play the big and little drums, the fiddle, the piccolo and the flute. It would be better for students to learn one language, and the grammar of it, than to attempt to master a number of languages simultaneously. There was another point in connection with the paper, which would be of great importance to our own age, and even more important to the ages which would succeed. One had now to reckon with a totally different phase of art altogether to that which had formerly existed, and it must be recognised by artists in the future. He referred to the marvellous powers of modern science in giving man the power of reproduction of art. It was useless to say that whereas the ancients did each single piece of work by hand, and that each piece was the work of one man, that we, with the astonishing powers of reproduction at command, should not take account of the perfectly natural demand for the possession of works of art. It must be remembered that a man could do the most delicate thing in wax which it was possible to imagine, a large work exquisitely covered by ornament, and that this could be put into the hands of a skilful workman, without any artistic feeling, who would, by the aid of the galvano-battery, produce an exact *fac simile*, or twenty *fac similes*, down to a hair's breadth, absolutely faithful, and each of the twenty as good as the last. There were many people who would say that was very bad art; that one must have one thing made by one man for one purpose, and that it should not be reproduced. To which he was inclined to ask—why not? If the design were done in wax with the mark of the artist on it, there surely was no reason why it should not be reproduced. He did not say it should be reproduced ten thousand times—that would be a bore—but it could be sent to different parts of the earth, where people were no likely to be bored by seeing it in too great profusion. That was a phase of the matter which he regarded as very important. Why should one rejoice at the reduplication of the works of Shakespeare and not at the multiplication of a good bronze statuette? It was much to be wished that we could easily master the process of cheaply multiplying small castings, and in such a way that the surface would be perfect. It would be a great discovery, and it would then be possible to reproduce the most lovely work and put it within the reach of everybody at a reasonable rate. He thought that would not be at all derogatory to art; in fact modern art would have to reckon with it. In the future artists would have to face that question of reproduction treated properly. He did not refer to the horrid Birmingham jewellery in the design of the open anchor, with a lozenge-shaped locket, with a piece of rope turned in one way and a ring in the other, which may then be dipped in nitric acid so as to take away the gleam of the metal. They lasted about ten years, and were then sent to be broken up; and with regard to the future, looking at the great difficulty and expense of procuring a work of art, and looking at the distribution of wealth and the desire of all to have artistic work in their own homes, the scientific methods of accurate reproduction would have to be reckoned with, and art would need to modify itself accordingly. He confessed he would have liked to have heard that rope ornament traced out, which was also used in Italy, and perhaps that could be done in a future paper. He did not know its history sufficiently. He wished to ask the author whether he thought the spirals were entirely derived from Greek art, or whether there were traces of some other art from which those spirals could be derived. Probably it was a difficult question, and very likely it was easier to ask such questions than to answer them.

Mr. T. R. Ablett thought that the educational truths expressed by the author were good sound common-sense. As far as he knew, those ideas were thoroughly in accord with those of many modern educationalists. He had spoken of the heart of a style, and had exhibited a most interesting series of slides giving the steps in the series, showing the evolution and development of style. He did not know whether those who had been connected with design had gone into the question of evolution, but it seemed to him that there were a series of steps which were absolutely inevitable. He had tried the experiment of giving to a large number of people a simple problem, and they had worked by a co-operative method, each knowing the other's work. It

had been found that the ornament obtained under those simple conditions had followed a definite course of development. That was not only so in one case, but the same problem presented to other people at different times had almost invariably produced the same evolutionary steps. So it seemed necessary, in order to get at the heart of a style, to start with the first step in its evolution and thoroughly realise that. By the adoption of such method from the educational standpoint one would return to nature's methods. It was not only in art that those methods were advocated, but also in science; the power of original research was the one most valued now by scientific and advanced thinkers in connection with science teaching. Another very important matter spoken of by Mr. Coffey was the reduction of the resistance between the mind and its expression. There could be no doubt that the teaching of many styles and methods to young people did seriously interfere with their own self-expression, and put obstacles in the way. He (Mr. Ablett) was connected with a movement to restore the natural pictorial art of childhood. The secret of that seemed to lie in taking away all obstacles between the child's own observation and thought, and their expression by self-invented methods of delineation. The teaching of styles and methods no doubt produced self-consciousness, and it was that self-consciousness which destroyed individuality in art.

Mr. CYRIL DAVENPORT said he only wished to ask Mr. Coffey one question, and that was the one which Mr. Cunynghame had mentioned, as to what was the origin of the spiral. He (Mr. Davenport) was inclined to the belief that it was a natural form. There were several things in which it was to be found. It shows beautifully in some shells, as well as in the tips of the tails of certain animals. The tip of the prehensile tail of the hippocampus showed it beautifully. Did Mr. Coffey think that the spiral was likely to have been derived from concentric circles? Otherwise he thought the slides shown exhibited clearly the fact that Celtic art in its later forms afforded a key-note to the English schools of design. He hoped that some day Mr. Coffey would come and say something more in continuation of what he had said on the present occasion about interlaced designs, which were very beautiful.

Mr. W. COLDSTREAM said it could not but be interesting to students of anthropology to compare the forms of ornamentation which had been projected on the screen that evening with those of other nations, and of peoples in other parts of the world. He (Mr. Coldstream) possessed coins of the Indo-Afghan period, 700 or 800 A.D., which bore on them the representation of animals with the joints articulated in a similar manner to those shown on the Celtic sculptures, particularly silver coins of Samanta Deva. That was a very interesting fact as emanating from another part of the world altogether.

Mr. A. MILLAR said he had no special right to speak on the present subject, but he wished to add his voice to the general chorus of appreciation which had been expressed. At the outset he was a little disappointed that the paper was to be so limited in scope, but as it developed that feeling entirely left him. The method pursued by Mr. Coffey of giving his whole attention to one particular branch, and that such a very important one, had been fully justified by the result. He had enjoyed the paper intensely, and had learned a great deal. He wished to say a word on the form which Mr. Coffey showed on the second slide. It was the starting point from which most of the succeeding ornaments developed, a circle containing two comma-shaped forms, and, later, three. He had a theory that this was naturally evolved in an accidental way; for instance, in idly playing with a pencil or folding a leather strap. Similar forms occurred in Cashmere work generally, such as shawls, and it was possible that they had been evolved in some such way. With regard to the education question and the method of teaching the student, of course it was very desirable that he should learn one thing thoroughly, but probably the reader of the paper did not mean that, having learnt one style, he should not go on to others. One thing which had to be remembered, was that the designer must live, and he feared that that prosaic view must prevail under present social conditions. He did not think the designer would further that end by adhering closely to one period, because he was likely to be asked to design in a particular style, and if he had not learnt that style, he did not think any degree of familiarity with another, however well he might have become saturated with it, would be of much service to him.

Mr. DAVENPORT said, that in some of the ornaments he recognised a likeness to the triskele. Was that accidental, or was it derived from the East?

Mr. ROMILLY ALLEN said, that in all spiral ornamentation it would be possible to make three, or four, or five spirals to meet in the centre, though in nearly all cases it was three, and that was a survival of the Triskele symbol. With regard to the circle filled in with an S-shaped curve, that was the symbol in China of the Yung and the Yin, as he believed it was called, which was supposed to be the male and female element from which the world was derived. A matter which Mr. Coffey did not point out, was that no example of Late-Celtic sculpture in stone was known to exist until a few months ago, until Mr. Coffey's article on the subject appeared in the "Transactions of the Royal Irish Academy;" so that the stones with the flamboyant design were new to archæology.

Miss ELEANOR HULL asked whether Mr. Coffey could explain the similarity between the Norse and Irish patterns. No one could go into the Museum t Bergen without being struck by the apparently

Irish style of the ornamentation. Dr. Karl Blind showed at the Viking Club a pre-historic sun-chariot which had been found, and on it there was spiral ornament.

Mr. DOUGLAS COCKERELL said in regard to the educational side of the question, he agreed with Mr. Coffey's remarks as to the necessity of teaching ornament from the beginning of a style. If they had not had an opportunity of previously studying the evolution of a style, but were brought into contact with the perfected style; *i.e.*, with the style as far as it had been possible to carry it, they were induced to either parody or *fac simile* it. But in order to get a student to make living ornament, he thought it was absolutely necessary that he should begin where the style began, and go through the evolution of that style, as Mr. Coffey had done that evening. The student treating a style in that way would find at every step of the evolution an opportunity for branching out in other directions, and evolving a style of his own, but based upon the history of the style he was studying. In that way one might get individual styles based on the old ones, and not parodies or *fac similes* of the perfected examples to be found in the museums.

The CHAIRMAN said the reader of the paper had opened up to him rather a new view of Celtic ornament. He had thought of it much more with regard to the interlacing type than of scroll work, such as Mr Coffey had so carefully developed on the present occasion. He (Mr. Day) would in future look at Celtic ornament with new interest in the light of the new knowledge which Mr. Coffey had imparted to him. He did not know whether Mr. Coffey had said who started the scroll, but he would like to hear. With regard to ornamentation of the horses' flanks, he had seen such decoration of horses' hind quarters in Oriental work, and had always regarded it as in some way of Persian origin. He was struck with the resemblance of some of the patterns exhibited to Japanese art; and Mr. Romilly Allen had told them that some of the forms were related to Chinese. With regard to the division of the circle into two and into three by the S shape, it seemed to him that there was a natural and obvious derivation of that. If, from some symbolic reason, it were desired to halve the circle, the ornamentist would naturally choose a wavy line, as being more in harmony with the circular shape, and the full curve would be developed naturally. Whatever the source or symbolism of the spiral might be, one need not look to shells or to the hippocampus for it; the hand naturally took that form; the wrist action gave it. There were many ornamental forms which were developed naturally. If a man were born without any artistic inheritance or knowledge of ornament, and were to start doing ornament unaided, he could hardly help going on certain lines. That, he thought, accounted for much of the similarity which one saw in ornament from very various sources, and the prevalence of the wave pattern and such-like forms. He was not competent to say anything instructive on Celtic art or ornament, but he wished to make one or two remarks on the teaching of art. Mr. Coffey suggested that the student should be taught one style, and he agreed with him that one style should be taught thoroughly; but he also thought the student should be taught many styles. He went in opposition to his friend Mr. Ablett; he did not think the teaching of styles interfered with the individuality of the artist in the least. The reason why individuality was not shown by an artist was because it was not in him; not by any means because it had been educated out of him: it had never been there. He would have students taught many styles of ornament, taught the best that could be done; and when they knew what ornament was he would let them choose. The art of the future had got to be eclectic. If students were worth a rush they would do something of their own. He did not believe in the instinct of "living ornament," as it was termed, being tamed or trimmed, or educated out of anybody in the world. He must say a word upon one remark which was made by Mr. Coffey, namely, that museums were not wholly beneficial. He (Mr. Day) would like to hear of something which was wholly beneficial. Tradition being dead, he thought the only thing one had to look to was museums. He said that not specially in order to controvert what Mr. Coffey had said, but because it was being preached extensively just now that a museum was a conglomeration of things which one ought not to study; that one ought to go only to nature. He believed that was all nonsense, and that those who did not study in museums would regret it by and by if they desired to study ornament, or particularly if they wanted to design it. Art should be natural and spontaneous, as all would admit; self-consciousness was a modern vice; but it was not by any means confined to ornament. If an uncultured or unread person said a thing well and naturally, that was not art; it might be beautifully said, it might be much better than art, but it was not art. The art consisted in saying it consciously with a definite purpose and knowing its effect. He admitted the artist did his best art when he was not conscious; *i.e.*, having learned to do the thing consciously, whatever it might be, in moments of great emotion he was carried away, and, without knowing it, his expression ran into the grooves in which he had trained himself consciously to go. The result was he did a great work spontaneously.

The CHAIRMAN proposed a hearty vote of thanks to Mr. Coffey for his paper.

Mr. PHILIP NEWMAN said he would like to be allowed to support the vote of thanks. The meeting had had the advantage that evening of hearing a paper on two important points—he separated them very distinctly—one on Celtic ornament, and the

other on art education. It had been impossible to follow both, and he had not attempted it; he had simply enjoyed himself to the full in looking upon the beautiful examples of Celtic art which were thrown upon the screen. He could not agree with much that had been said about art education in connection with those things. He thought that the man who made that magnificent sword sheath, must have studied in all the schools of art from time immemorial, and having that full knowledge within himself of the due proportion of mass to space which constituted the source of excellence in all decorative art. He felt he would like to say how much he had enjoyed seeing those things, and learning so much about the scroll work in differentiation of the strap work, which was a very important matter.

The vote of thanks was carried unanimously.

Mr. COFFEY, in reply, said one speaker, the Chairman, had asked what in this world was wholly beneficial. He would answer that such a discussion as the present was wholly beneficial if it could be continued and the opponents be brought down into the arena. One must agree to a large extent with Mr. Cunynghame. The casts of statues in the museums were reproductions. But the introduction of machinery into art for purposes of reproduction in modern times had led to what had been called in art, death. The use of machinery for the purpose had been sought to be justified on the ground that it enabled such a large number of people to enjoy those reproductions. His feeling was, that between life and death there was no relation, and one could never feel human sympathy towards anything which had not been touched by the human hand. Things produced by machinery might be very interesting, and might appeal to one's knowledge of science, but it did not seem to have human relation with us; it seemed rather to be something which was created outside us. There would always be that difference between people; it was a matter of temperament. But to him, personally, the moment he detected a machine behind the object he ceased to have anything to do with it; it did not seem to belong to the region of life, and one felt no emotional sentiment towards it. That would not militate against works of art being reproduced in the sense of copies in which the hand of the artist was seen in the copy. But at the same time, had we not a little too much of art? Did one want those reproductions? Was it a wise thing to scatter them all over the world? He did not think people were trained and educated in art by having beautiful things put before them. One found races with the most certain sense of art and taste and surety of eye, who would at once rush to the meretricious thing which was new and novel. If anyone went to Egypt and Persia, where art was immemorial, the moment those people were shown a vulgar Western production they were delighted with it. Thus being surrounded by beautiful things did not seem a safeguard against admiring the ugly and the meretricious. The question of spirals was a large one, and almost purely archeological. The argument ran that if they were a natural form they were not natural to all people. Some people never had the spiral, but seemed to develop along straight lines and chequers. In early times the range of the spiral in Europe was geographically limited; it passed along certain routes of trade, but did not spread or develop in other countries. The earliest spirals known were produced in pre-historic times in Egypt; they then spread over the Mediterranean and along the trade routes to the Danube, the Elbe, and the Baltic; but they were not Western. On going back far enough, one found that every people did not invent the spiral; that it began in certain centres, and spread by contact. The S loop was a form which could be easily got, but it was also the return of the spiral. At the end of the Bronze Age one found a simplification of the spiral in the form of the S turn. He took it that that was the influence which led to it being taken up, and the Celts influenced by their feeling for the spiral had developed the other patterns which had been shown. It had been said in the discussion that the designer had to live. He denied that. Why had he to live? A bad designer certainly had no business to live; he must justify his existence. Of course, in the present age, designing was a commercial matter. It was not art, and the schools of design were started with the deliberate intention not to produce art, but to produce an art commodity, and that had been the fundamental error. A start was deliberately made with the idea of making money out of it, and the money was the aim, not the art. It was a case not of losing one's life o save one's soul, but the other way. Mr. Romilly Allen had spoken of the triskele, and it was unnecessary to say any more. As he said it had probably a symbolic meaning, and its retention was felt in the form, just as we might fell the influence of the form of the Cross. In answer to Miss Hull, he did not know that the Norse forms had anything to do with the patterns he had been dealing with, the latter were rather earlier. The influence was felt somewhat in the Baltic, but it was not quite the same family. The sun disc with the spirals was of the Bronze Age, and was related to the Mediterranean spiral of the early times. In answer to the Chairman's remarks he did not mean that the student should stop at one style, or that he should not learn as many styles as he liked. His point was that he should master one style, the reason being not the acquirement of the style, but the acquirement of the power of decoration, which was a different thing. It was not merely the terms or forms of the particular pattern, but the sense of caress and proportion, and the manner in which the pattern was to be used for a particular purpose. That was a capacity which had to a great extent been lost; the tact and constraint which told one when to stop. What he saw

was the overloading of ornament everywhere, the feeling that ornament was a thing which was good in itself, and that a building or object was to be ornamented because it was necessary that ornament should be on it, that it would not sell without a certain amount. That was demonstrated when people distinguished between things which were art and things which were not art; for instance, they spoke of "art furniture," "art drapery," "art china." The moment people came to do those things they had lost touch with art. He fully endorsed the Chairman's remark that art was essentially conscious, that is individually conscious to the artist, but when it was the controlling spirit it was also unconscious in the same way as a language was unconscious. That having passed away, the artist became individualist. One could not hope to again see a national art so long as the present form of society lasted. He did not think a national art was possible, except in conditions where the people made their own things, and where that applied from the highest artist to the villager. He doubted if a people had the power of enjoying art who could not do something with their own hands. Otherwise art could only be a luxury. Once art had left the cottage, it had left the people. With regard to museums, he did not mean that museums should not have art of different kinds in them; but that a sort of congestion of the brain was produced by bringing together the art of the whole world, and dumping it in museums. It must be recollected that those things came out of races which had centuries of years behind them. It was just like mixing very divergent breeds. Herbert Spencer's letter published the other day, spoke of the impossibility of breeding from animals which were far apart, the results in the second generation being extremely bad. He thought it was the same with regard to art. When there was a great display of Indian, Renaissance and Gothic, a student could not be let loose on that. The great point was to teach him the styles at the beginning. At the present day there was a surfeit of Renaissance work. It was not good, but debased Renaissance, and our museums unfortunately had too much of it in them, because it was easy to procure. It was difficult to get original examples of the earlier periods. He expressed his cordial thanks for the kind way in which his paper had been received. He was glad he dealt with it in the way he did, because it had provoked a very good discussion.

NINTH ORDINARY MEETING.

Wednesday, February 10, 1904; HENRY H. S. CUNYNGHAME, C.B., Member of the Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Bell, William, Hill Crest, Walmer, Kent, and Junior Constitutional Club, S.W.

Dean, Frederic William Charles, M.I.Mech.E., Royal Arsenal, Woolwich.

Delmé-Radcliffe, Lieut.-Col. Charles, British Commissioner, Anglo-German Boundary Commission, Uganda, East Africa.

Dennis, Henry Herd, Cognac, Charente, France.

Pennington, R. W. R., Carbonic, Mazagon, Bombay, India.

Rudorf, George, Ph.D., B.Sc., 26, Weston-park, Crouch-end, N.

Schweich, Emile, F.C.S., 20, Hyde-park-square, W.

Stanley, E. A., The Electric Railway and Tramway Carriage Works, Limited, Preston, Lancs.

Taylor, R. N., 17, Canonbury-square, N.

Thompson, Edgar W., A.M.I.Mech.E., Boyd's Ice Factory, near Ballard Pier, Bombay, India.

The following candidates were balloted for and duly elected members of the Society:—

Findlay, Archibald, Mairsland, Auchtermuchty, Fife, N.B.

Garnett, Miss Annie, Fairfield, Windermere.

Kendal, Frank, 428, Strand, W.C.

McKerrow, H. B., Eversley, Wilmslow, near Manchester.

Oatway. George Henry, The May-Oatway Fire Appliances, Ltd., 49, Queen-street, Glasgow.

Stocken, Alfred, 144, Fulham-road, S.W.

Stovold, Herbert William, A.I.E.E., British India Steam Navigation Company, Ltd., Bombay, India.

Vickery, John Collard, 179-183, Regent-street, W.

Voegelin, Albert, M.A., 35, Castelnau-mansions, Barnes, S.W.

The paper read was—

THERMIT: ITS APPLICATION TO METALLURGICAL ENGINEERING.

By C. V. Boys, F.R.S.

Preliminary.

Before I come to my subject proper, which relates to a material which depends for its peculiar and valuable properties upon the unique characteristics of aluminium, which, however, in some respects, it shares with magnesium, it may be worth while to draw your attention to a number of curious properties of this peculiar metal, in which again magnesium is found to behave similarly to aluminium, either in greater or less degree.

The obvious characteristic of aluminium with which we are all familiar, is its lightness; not only is it light in the gross, but chemically it is light also, its atomic weight being only 27. The low atomic weight carries with it, as is well known, a high specific heat, and this, together with its large latent heat, give rise to the peculiarity that it takes a long time to melt

aluminium, even though the melting point is only a little above that of zinc, namely, quite a dull red heat.

According to Richards, it takes more heat to melt aluminium than the same weight of cast iron, two and a half times as much as for platinum, and nearly five times as much as for gold. When melted, at once a new peculiarity is apparent; it appears in the crucible to stand up above the lip, as though it were not fluid—it is sometimes even called pasty—and it seems as if it would be difficult to pour, yet it is perfectly fluid, and is capable of making the most exquisitely fine castings. This capacity for standing up is simply caused by its high capillary constant, as compared with its density. In the workshop, aluminium, when pure, is a disappointing metal, and, in spite of the numerous aluminium solders, it is not so easy to handle where solder is necessary, as we should like.

In connection with the difficulty of soldering aluminium, it might be worth while to refer to a further peculiar property of aluminium, namely, its power of adhesion to glass when rubbed upon it.

This property of aluminium is described by M. Margot in the "Archives des Sciences Physiques et Naturelles de Genève" for 1894, but a sufficient account is to be found in that most valuable book, of which the title is "On Laboratory Arts," by Professor Threlfall. Not only does aluminium adhere to clean glass when rubbed upon it, more especially if the glass has been lightly dusted with rouge, or with alumina, but, strange to say, the very fine aluminium deposit so made, can be soldered by means of M. Margot's aluminium solder, of which the proportions are 92 per cent. tin, and 8 per cent. zinc. It seems extraordinary that it should be possible to solder pieces of glass together through the intervention of a rubbed-on film of aluminium, more especially when we remember how troublesome in the ordinary way aluminium is to solder. Professor Threlfall and Dr. Watson now solder quartz fibres in instruments by means of aluminium solder.

Aluminium further possesses the unique property of enabling clean metal ingots for plates between which is interposed a thin sheet of aluminium, to be welded simply by hot rolling. The Compound Metals Company have kindly sent a number of specimens of sheets so made, and of articles made from them from thick copper-plated steel for ships' plates to quite thin foil, including all kinds of combinations of metals. It is impossible to see any limit to the importance or ultimate scope of this process, and I should strongly urge that a paper dealing with it exhaustively should be arranged for by this Society.

Another very curious property of aluminium is its value as a fine hone; its capacity for giving a fine edge to razors, lancets, and other tools requiring a fine and keen edge, seem to me to indicate that, in spite of all the care that may be taken in casting, the oxide which forms upon its surface, to a certain extent is diffused throughout the mass. I cannot believe, myself, that a pure soft metal such as aluminium can itself have any abrasive action on hard steel. If, however, ultra-microscopic particles of oxide permeated the mass, then it is not difficult to realise that an excessively fine hone would be the result. Perhaps the most remarkable property of all that aluminium possesses, is that discovered by Pollak, of acting as an electrode in a phosphate of soda solution, which will allow the current to go one way, but not the other, acting, in fact, as an electric valve when inserted into an alternating current circuit, even though the pressure is as great as 180 volts.

However peculiar the physical characteristics of aluminium may be, it possesses a chemical property, in which, together with magnesium, it surpasses all other metals, namely, the production of an enormous quantity of heat on combining with oxygen.

It may be worth while, by means of a simple experiment, to give some evidence of this and of the high temperature evolved in the combustion of aluminium. I have here a small glass jar, in which two or three leaves of aluminium are lying loosely at the bottom. The jar is filled with oxygen gas. On dropping a minute splinter of red hot charcoal into the jar, it at once sets fire to the metal, and a flash is produced of such dazzling brightness, that those who see it will not see anything clearly for a little time. It may be interesting to state that the oxide bombards the glass with such effect, as to apparently enter its substance, so that it can never be made clean and bright again.

The enormous temperature developed by the combustion of aluminium in oxygen, or when mixed with any material containing oxygen, has been made use of recently in an explosive of which I heard for the first time about a year ago, but I am not now able to ascertain what is being done with it. The explosive consists

simply of ground aluminium and nitrate of ammonia. Here we have a mechanical mixture in the same sense that gunpowder is a mechanical mixture, as distinct from an explosive compound such as nitro-glycerine, yet this mixture can be fired by detonation, when it explodes with the suddenness of a true chemical explosive. This is the more remarkable, as—unlike all recognised explosives—here the product of combustion is not wholly a gas, but largely a solid, so that there are only the residual gases of the nitrate of ammonia to produce the explosive pressure, and this is only rendered operative by reason of the fearfully high temperature.

Reduction by Aluminium.

From figures that I shall give shortly, it will be evident that aluminium not only must be, as we know it to be, most difficult to reduce from its oxide, but when reduced it must have, in its great affinity for oxygen, the capacity of reducing other metals. Similarly it is able to annex other negative elements besides oxygen, such for instance as sulphur, chlorine, fluorine, &c., but on the present occasion we are mainly concerned with oxygen.

A well-known operation in assaying, consists in removing the sulphur from galena, that is, native sulphide of lead, by means of pieces of iron all put together into a crucible with a little flux, and heated to a red heat. Then the iron takes possession of the sulphur, forming a slag containing sulphide of iron, and the pure metal—lead—is found at the bottom of the crucible. In this way, the proportion of lead present in a sample of galena, can be rapidly and well determined. This is an exact counterpart of the action which is the basis of the material, called "Thermit."

Heat of Combustion of Aluminium.

Having spoken generally of the great heat of combustion of aluminium, I should next give some figures to make our ideas more precise. Instead of comparing the heat generated by the combustion of one pound or one kilogram of a material, it is more convenient for the purpose of comparison to choose a number of pounds or kilograms that combine with 16 pounds or kilograms of oxygen, 16 being the atomic weight of oxygen. Richards, in his great work on aluminium, gives such a table—and the same figures may be deduced from Lupton's handy little table—from which it appears that magnesium heads the list with 145,860 large calories set free by the combustion in oxygen of 24·4 kilograms of magnesium. This is followed by aluminium, 18 kilograms of which in combining with same quantity of oxygen, set free 130,500 calories. The metals of the alkalies and of the alkaline earths follow closely. A long way behind come ordinary metals and hydrogen, while carbon, our best fuel, is far behind. Of ordinary metals iron is of special interest to us. Thirty-seven kilograms in becoming Fe_2O_3 give out 63,700 calories or absorb this amount of heat in being reduced again. If the reduction is effected by the action of 18 kilograms of aluminium, the heat developed will be $130{,}500 - 63{,}700 = 66{,}800$ calories. As 71 kilograms of material are involved, *i.e.*, as nearly 1,000 calories are set free per kilogram of mixture, the temperature attained must be several thousand degrees if the mean specific heats of alumina and iron through that great range of temperature and their latent heats of fusion are at all comparable with those of ordinary materials. Another consideration—limiting temperature—is the inability of elements to combine when a certain temperature is exceeded so that a higher temperature cannot be produced by their combustion. In the case of our ordinary fuels, carbon and hydrogen, it is this rather than lack of heat units that limits the temperature of a furnace fed even with hot oxygen. In the case of aluminium, however, a much higher temperature is possible; whilst, therefore, the total development of heat of the reaction just described is known pretty accurately, it would be difficult to calculate with precision the temperature reached on account of our imperfect knowledge of the latent heats of alumina and of iron and of the varying specific heats of the materials at these high temperatures.

The temperature could be determined by radiation measures on the principle of the "absolutely black body," which, however, seems a strange way of speaking of such a dazzling blaze, but I am not aware that any measurements of the kind have been made as yet. Wyborgh, however, has made a measurement involving of necessity considerable extrapolation. He placed a small charge of fulminate of mercury in a magnesia tube, and having prepared a number of identical specimens, he subjected them suddenly to known temperatures by casting metals round them at these temperatures, then, when the fulminate reached a certain temperature, it exploded. The times taken between the casting of the metal and the explosion

was observed to get less, of course, as the metal was hotter up to the highest measurable temperature, as follows:—

Temperature of Metal.	Time before Explosion.
300 degrees C.	180 seconds.
1,900 ,,	30 ,,
2,000 ,,	29 ,,
2,100 ,,	28 ,,
2,250 ,,	27 ,,

When the melted metal was replaced by the thermit iron the explosion took place in 22 seconds, from which a temperature of about 3,000° C. was deduced.

Of course extreme accuracy must not be looked for after so great an extrapolation, but the result cannot be seriously incorrect.

Thermit Iron and Metals.

Not only iron, but other metals, as already mentioned, may for similar reasons be obtained in a state of great purity and fused by this process. I would specially point out that the iron obtained in this way, though it is fluid, and may be cast in moulds, is not "cast iron," but pure melted wrought iron. It may have its softness modified somewhat by the admixture with the thermit of small quantities of manganese, titanium, chromium, or other metal, or it may be carbonised to a moderate extent by adding to the mixture high carbon steel or cast iron. The temperature is in any case so high that it is desirable to reduce it somewhat. This is most advantageously done by the addition of some 10 per cent. or so of sheet iron punchings where the thermit iron is intended for welding, or even a larger amount where a lower temperature will suffice. This possesses the further advantage that the yield of iron per pound of material is increased. When in future, therefore, I speak of thermit iron as being used in any welding operation, I do not mean "cast iron," or necessarily pure iron free from carbon, but iron to which, if desired, the required degree of hardness has been given by the addition of one or other of the materials mentioned, but which is always ductile.

History and Development.

The history of thermit dates back to the year 1894, when Claude Vautin, of the City of London, made use of aluminium mixed with metallic oxides, sulphides, chlorides, &c., to effect a corresponding reduction of metals with which oxygen, sulphur, or chlorine might be combined. He found on mixing aluminium in a finely divided state with these bodies, that the mixture when heated in the crucible to a sufficient temperature, would react as already described, and that the mass would attain an intense heat, in virtue of the enormous heat developed by the oxidation of the aluminium. So great was the temperature, that metals ordinarily intractable and infusible, such as chromium, could be reduced and obtained in a compact form. Not only this, but the absence of carbon made it possible for the first time to obtain many such metals with a degree of purity hitherto unknown. One drawback, however, resulted from the very great temperature set up, namely, there was risk of losing a large proportion of the contents of the crucible, which was apt to be more or less violently projected into the air.

The next stage in the development of this subject, as shown by the records of the Patent Office, was made by Vautin a little more than two yeats later. In his specification of 1896, Mr. Vautin describes his next step. Instead of heating the materials in the crucible up to the point at which reaction begins, he ignites a portion of the cold mixture by the aid, either of burning magnesium, or of a special ignition powder, which he there describes, consisting of finely divided peroxide of barium and aluminium. This mixture is specially valuable for creating high temperatures, because the peroxide of barium is quite ready to give up its extra atom of oxygen, and the product—namely baryta and alumina mixed—is solid, so that there is no loss of temperature owing to the latent heat of a liquid, or still more so of a gas. A little of this mixture, which is easily lighted by a match, may be placed upon the mixed oxide of chromium, manganese, or whatever the metal may be, and aluminium, and ignited. The local heat is so intense as to start the reaction in the mixture in immediate contact with it. The heat produced by this is so great as to set up the reaction in surrounding quantities, and so a combustion gradually proceeds through the mass, after which the metal is found at the bottom of the crucible, in a pure melted state, and the alumina, or oxide of aluminium, remains floating on the surface.

So far as the records go, there is no means of telling what Vautin did with his invention; judging by my experience of the way in which invention is looked upon by the majority of our English manufacturers and capitalists, it is likely that Vautin can have found nothing but

discouragement wherever he turned. This, however, is pure imagination on my part, I have no direct knowledge that it was so. At any rate about six months later we find that Vautin's mixture began to be turned to account in Germany, where Robert Deissler made use of the heat of the reaction as a convenient way of heating up metal quickly.

Dr. Goldschmidt's Inventions.

Nearly three years later we find Dr. Hans Goldschmidt coming upon the scene with a further invention for utilising the heat of the reaction that I have described, for the purpose of welding iron. To Dr. Goldschmidt further, I believe, should be attributed the invention of the word thermit, a convenient fancy name for the mixture, especially of aluminium and oxide of iron in fine grain, and in chemical proportion. Dr. Goldschmidt has been most active in the last few years in the development of a number of inventions designed to utilise either the heat of the reaction or the product of the reaction or both. Supposing, for instance, that a butt weld is desired between two bars of iron or steel, or between two pipes or angle irons, or channel irons, or iron bars of any other section, two distinctive, methods have been devised by Dr. Goldschmidt. From what I have aready said, you will understand that a crucible of the mixture which I shall now call thermit, after ignition consists of two layers, iron below, in an amount nearly half the weight of the original thermit, alumina above, both at a temperature approaching 3,000° C., so that it cannot be looked at without risk to the eyes. This double layer may be taken out of the crucible by either of two methods: it may either be poured out of the top, like castor oil over ginger wine, in which case the lighter material goes first and is followed by the heavier; or it may be run out through a small orific at the bottom of the crucible, in which case the heavy iron will go first, and be followed by the lighter alumina.

Pipe Welding.

In the case of a weld in a pipe, or in an angle iron, it is probably desirable that the body of the weld shall, when finished, be identical in section with the rest of the material, so that on no account must any iron produced by the action of the thermit remain adherent. If this is the object, a simple mould is placed round the pipe or bar to be welded, leaving a space which experience has found to be suitable, the two ends are securely held in position by means of clamps, so that when desired a considerable pressure can be exercised between them. Then, when all is ready, the charge of thermit in the crucible, the amount of which for each section is known to a nicety and is tabulated, is ignited, and as soon as the fluid has become quiet, it is poured into the mould. As it is difficult to see the mould in consequence of the glare from the crucible, it is desirable just to splash a little alumina as near as can be judged, into the mould, when at once the glare from this will make the opening into the mould easily seen, and the rest of the mixture can be gently and gradually poured in. Now, in this operation, the alumina going first immediately chills in contact with the cool metal, thus forming a protecting layer, which prevents the iron that follows from damaging, or adhering to the bar. The heat of the mixture,—again iron below and alumina above, — quickly heats up the bar or tube to the welding point, and if the space below, where the iron is, has been properly proportioned, and a proper quantity of thermit has been taken, the temperature of the bar or tube will reach a welding point, but will not reach the melting point. After a time, varying from one minute to three or four, according to size and thickness, it is merely necessary to exert pressure by means of the clamps, and the weld is complete. Immediately—that is while still white hot—the mould is removed, and the hot iron and alumina are knocked away, when there is nothing more to be done but to leave it to cool.

The moulds for this pipe welding, the dimensions of which have been carefully tabulated by Dr. Goldschmidt, may either be made of two casings of sheet iron with sand between, or sand moulds of the right form, such as are used in foundries, may be employed. The crucibles are not of the usual kind adopted to be heated in a fire, but consist of a perforated sheet iron casing lined with an inch or more of magnesia.

Rail Welding.

The second method of making a weld is that which now appears to be, commercially, the more important, namely, to use, not only the heat of the reaction, but to utilise the iron formed by the thermit as well as the heat. Perhaps the most extensive use that has been made of this method of welding, at any rate in

this country, has been in the welding of street tram-rails. In this case, there is no objection whatever to the thermit iron being allowed to adhere to the rail ends, forming a shoe round the foot and web of the rail. By this means the heat of the reaction is more completely utilised, so that a smaller quantity of thermit is sufficient to raise the ends of the rail to the welding point, and even to melt, to a certain extent, the surface.

I have upon the table the whole of the appliances needed for making these rail joints, and I have also some lantern slides of photographs that have been taken showing the process as carried on in this country, in Germany, and elsewhere. It will be noticed that by contrast with electric methods of welding, the plant is almost non-existent. These joints are now being regularly made by the Corporation of Leeds, who were the first in this country to adopt the process on a large scale. Up to the present they have had material for more than 3,000 joints. Mr. John S. MacGregor, the Permanent Way Engineer to the Corporation, is more experienced at the present time in thermit welding of tramway rails than anyone in this country. As is to be expected, those who are responsible for the work of the Leeds Corporation, would not have adopted such a system, had they not by practical trial satisfied themselves that joints so made are in every sense satisfactory. Owing to the kindness of Mr. J. B. Hamilton, the General Manager, I have been given permission to publish the results of a series of tests that they have made upon some of these joints. I have given these in an appendix.

The tests speak for themselves, and show (1) that the joint is far stiffer than the usual one made with fish and sole plates; (2) that the electrical conductivity is better than that of the unjointed rail; and the conclusion is that there is no more any occasion to subject the rolling stock and the nerves of the passengers to the continual hammering of imperfectly connected rail ends.

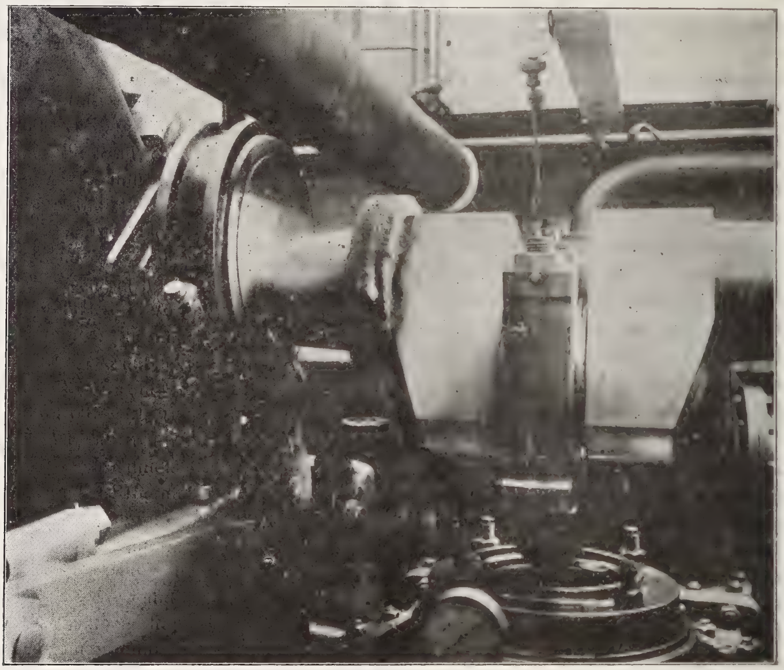
Besides Leeds some 15 other towns, mostly in the north, have used thermit joints, but up to the present not to the same extent.

Before dismissing the question of the welding of tram-rails, whether the welding is performed by the thermit process or is made electrically, I feel that I must, in spite of having done so many times already, refer to the expansion bogey which seems to scare so many people. I will not now go into all the figures, I have already done this* elsewhere, but the general results may be stated. Tram-rails that are buried in the street as distinct from rails on our main lines, that are exposed over their whole surface to the air, do not go through a large diurnal change of temperature, and even the annual range of temperature is very much less than that of the atmosphere. With a rise of temperature, the rail of course tends to expand, and with a fall, to contract, and the forces set up are, if that expansion or contraction is resisted, pretty considerable; but with the steel used for tram-rails, these forces are insignificant compared with the tensile strength of the steel, being only about 300 lbs. of tension to the square inch for every degree that it falls in temperature. Similarly, where there is a curve in the road, the lateral forces due to expansion or contraction become infinitesimal where the radius of curvature is large, and where it is small, an imperceptible movement of the rail, extending over half the year, is sufficient to relieve it of strain. The most serious conditions are those in which a sharp curve in a vertical plane, such as may be found in crossing a narrow bridge, unites two long straight lengths. Such conditions might lead to the actual lifting of the rail, and with it, of the road bed, in prolonged hot weather, but then there is no necessity to make use of a weld in the very few places which can be found, where a weld is likely to introduce trouble.

There is another point to which I should like to refer, before dismissing the welding of tram-rails; objection is often taken, that however good the joint, or however perfect the system may be, it must be a terrible undertaking to make any alteration in the rails when they are all welded into a single piece. Of course this objection, so far as it goes, applies equally to electrical and other methods of welding rails, besides that with which we are specially concerned this evening. The objection really is a purely imaginary one. Anyone who has used a hack saw only once or twice, and broken it or hurt his fingers in the attempt, cannot understand what a marvellously efficient instrument the common saw worked by hand is, in the hands of a man who has acquired the knack of using it. The tram-rail has a section of about 10 square inches, and is made of steel of moderate hardness. I was amazed—even though I

* "Proceedings of Civil Engineers," vol. cli., 1902, pp. 102-5.

believe I can use a hack saw with some effect—to hear that both at Leeds and Liverpool they have a man who can saw through the rail in twenty minutes, and who does not think much of the proceeding. How long it would take to remove fish-plates and sole-plates, held as they are by 18 or 20 1-inch or $\frac{7}{8}$-inch bolts, well rusted up or covered with pitch, I do not know, but the margin under twenty minutes cannot be so great as to make the sawing where it really may be required, in any serious degree an objection.



13-Inch Paddle Shaft of Rhine Steamer.

Machine Repairs.

The thermit weld may be of very great value in a break-down of machinery, for a piece that is broken away from a steel forging or casting, or even from an iron casting, may be replaced by thermit iron run into a proper-shaped mould; or if a crack has developed this may be enlarged with a chisel, and thermit iron run in and through the space, sufficient in quantity to heat it up so as to make a complete and perfect weld. Owing to the kindness of Mr. J. H. Jurriaanse, of Rotterdam (Wynmalen and Hausmann), I am able to show you a slide of a most interesting repair of this kind. The connecting rod of a large steam-engine, driving all the machinery in a wire, nail, and rivet factory in Holland, where 500 men were employed, broke in the fork at one end, and it was of the utmost importance that this should be repaired immediately as work was stopped until it was done. The repair of this connecting rod was undertaken by Mr. Jurriaanse, who, having the drawings, prepared the necessary mould, and had it ready when the connecting rod arrived. The photographs show the several stages of the repair, and it may be sufficient to quiet those people who never cease to be afraid of the effects of expansion and contraction, if I tell them that when the joint was cold, the connecting pin which had previously held one side of the fork correctly in position, simply dropped out. The whole of this repair was effected within 24 hours.

I should like to express at this step, my admiration of the skill and ingenuity with which Mr. Jurriaanse has utilised the powers of thermit. I have seen a number of specimens of experimental joints and of runners made by him, and it is impossible to imagine how they could be improved. Mr. Jurriaanse, whose experience is very great, has told me of one or two little points of detail which are of so much importance, that I should like to refer to them. In the first place, he adopts a plan to prevent the sand which is placed at

: bottom of the crucible, from entering the ould, a plan which would at least surprise yone seeing a thermit joint made for the st time. Having got everything ready for run, Mr. Jurriaanse places a piece of ¼-inch on plate over the opening in the mould, d then, when he taps the crucible in the ual way, the first splashing of iron and sand scattered, but the iron plate is no bar to the try of the thermit iron that follows, and so e iron enters the mould, but the sand is kept it. Another point of importance, in which the ginner persists in going wrong, is to wait r a time—which in the excitement seems iterminable—say half a minute or so after the action is complete, before tapping. This llows gas and particles of slag to get well eparated from the metal, and a more clean nd perfect run is to be expected, than any hat can be obtained if the tapping of the rucible is effected with undue hurry. There s another point to which he attaches some mportance; in order to ensure that the rystallisation of the metal shall be of fine rain, he gently and continuously taps with a ammer, the steel upon which a thermit weld s being made, from the time of the setting of he metal until the crystallisation may be con- idered complete, and finally he pays great ttention to a careful preliminary heating and nnealing, where that is possible.

As an example of an engineering repair which I fear it would be difficult to get ccepted in this country, I am able to show lides of a repair made in Austria, for the Austrian State Railways, to a locomotive driving wheel, from which you will see that in hree places, the spokes have had a break satisfactorily repaired.

A question that will very naturally be asked s: To what extent are welds made in this way?—really welds, and not mere patches— and if welds, to what extent may the utility of an otherwise sound weld be destroyed by contraction strains? I think the best answer to this is found in the fact that not only have broken teeth been replaced in steel wheels, and stood up to their work, but a far more difficult operation, and one which involves the most severe stresses known in engineering, has been successfully accomplished. I refer to the casting of new steel journals on the ends of the broken rolls of a rolling mill. This is hardly so direct an operation as any that I am describing this evening, and would take too long to describe in detail; but the method was devised by Prof. Matthesius, now appointed Professor of Metallurgy in the University of Berlin, and has been successfully accomplished. If a thermit-welded roll will stand to its work, it is hardly necessary to discuss the soundness and strength of the weld. I cannot give a better example of the British (it was in Scotland), mode of being interested in the progress of the arts than the answer of one of the engineers of a great steel works, to whom I was describing this process, as I saw a number of broken rolls lying about. He showed his superiority over a mere outsider, and his just appreciation, in the following words: "The thing is ridiculous, the roll cost £300."

Ship Repairs.

The success with which steel of moderate dimensions, such as has already been described, may be welded by the aid of thermit, naturally leads to the inquiry as to how far it would be applicable when the section of the metal, where a weld is desired, is very much greater say than 10 square inches. It is difficult, at first, to realise the possibiity of heating solid steel with a sectional area of say 50 or 100 square inches to the welding point, without at the same time, heating the metal through a considerable distance, which would inevitably be the case if the heating were performed by the use of an ordinary forge fire, which would require a greatly increased quantity of heat. The fact that thermit puts into our hands a temperature at least 1,000° Centigrade above that available in the forge, and the fact that the thermit iron carries its heat at a rate enormously greater than that at which hot furnace gas can possibly carry it, simply on account of its far greater density and conductivity, completely alter the usual circumstances, and further, the relatively less conductivity of the solid metal for heat when dimensions are great, as compared with that where the dimensions are small, makes it by no means so prohibitive a process to weld steel of the great dimensions of the propeller shafts or the framings of ships, as at first one would be led to expect.

In the case of a repair to a ship, the stake is so great, that there must have been great anxiety when the first repair of the kind was effected. This has now become almost a common operation on the Continent. The importance of the subject is such that it will be worth while to spend a short time describing, by the aid of photographs kindly furnished by Dr. Goldschmidt and Mr. Jurriaanse, some

of these repairs. The first of these shows the repair in various stages of the tiller arm of the steamship *Assyria*, 6,581 tons, which was welded fourteen months ago. The second shows the repair, in different stages, of a 13-inch crank shaft of one of the Rhine paddle steamers. This is the more interesting, as the position of the fracture is such where the shaft and the crank web join, that the stresses, twisting and bending combined, are most severe, and the repair could not have lasted had it not been effective. In this case, the crack was found extending more than half of the thickness of the shaft. The metal was cut away by means of cross cut chisels, so as to form a gap about $1\frac{1}{4}$-inch wide, until the bottom of the crack was reached. The process was carried out in the manner already described, but a ring of thermit iron was left on. The ship has been running ever since, and the result is entirely satisfactory. A certain number of repairs have been

REPAIRED STERN FRAME OF S.S. "SEVILLA," 5,135 TONS.

made in the stern frames of steamships which have been damaged in collision. The photographs of the s.s. *Sevilla*, 5,135 tons, showing the repair in various stages, are of special interest. The metal at the crack is cut away until a space of one or two inches is left. A mould, consisting of sand with sufficient clay to make it less friable, is prepared, in two or

ıree sheet iron boxes, so as to allow of the ıtrance of the metal at the lower part of the esired cast, and of the overflow of so much ıetal as would ensure the passage of enough ıermit iron through the gap as to bring the ıetal up to the welding point, and super- cially melt it. In the case of the s.s. *Sebenico,* ı order to avoid any contraction flaws, the tern post was forced outwards by means of powerful screw jack before the metal was un, and then, as the cooling began, the ack was gradually released, so as to keep he joint in a state of compression, Of these hips, the *Assyria* and the *Sevilla* belong o the Hamburg-American line, and from the ime of the weld to the present, *i.e.*, about 4 months, they have experienced the usual Atlantic weather, and no trouble has resulted. The *Sebenico* repair was carried out in the loating dock at Trieste, and was also entirely successful.

One of Mr. Jurriaanse's repairs to a dredger s interesting in that the heel just under the udder frame had been broken away in running aground. In this case, a new piece over three feet long was forged to replace the missing corner, but it was purposely made too short, so as to leave a gap at each end. This was welded at both places as described already. The photographs will make the process more intelligible.

Lunker and Titan Thermit.

Referring back to an early paragraph of this paper you will remember that I showed how, not only iron, but other metals may be reduced from their oxides by the aid of aluminium. In this way chromium, manganese, titanium, tungsten, and a number of metals may be obtained, free from carbon, and suitable for the purpose of making alloys, specially of copper or of steel. Specimens of several of these are upon the table. There is, however, a use for thermit containing some of these metals, to which I would refer, namely, the use of small tin boxes containing what Dr. Goldschmidt calls "lunker" thermit or "titan" thermit, which may be plunged, at the end of an iron bar, into ladles of cast steel or of cast iron, where the reaction sets up such a development of heat and such a churning and mixing of the metal as to make it possible to run thin and extensive castings in steel or in iron which, in the ordinary way, would be impracticable. The British Westinghouse Company have kindly given me permission to state that they are now using lunker thermit with this object, and they have sent me some specimens of castings so made which they found impossible before, of which specimens are upon the table.

The production of heat has been ingeniously made use of to prevent the formation of cavities in steel ingots. A small box of thermit, prepared for the purpose, is pushed into the head of the ingot just as the crust is beginning to form. The heat set up there is so great that, as the metal below gradually solidifies, the cavity which ordinarily is formed, and which spoils the upper third of the ingot, is kept supplied with hot, flnid metal, so that a very much smaller proportion of the ingot is wasted. The same purpose has been served where very extensive steel castings are made, by putting small boxes of special thermit in the risers at the distant parts of the mould. Where hitherto, the metal on reaching the riser has become too cool to be able to run back to supply the contracting metal during the process of feeding, the metal in the risers is made so hot, by the use of the thermit, as to get over this difficulty.

Artificial Emery.

Even the slag is useful. This being almost pure alumina, fused and crystalline, is nothing more than emery of unusual purity and sharpness, and emery wheels may be made of it.

Conclusion.

I must, in conclusion, express my obligation to Dr. Goldschmidt, to Mr. Juriaanse, and to Mr. Masterman, who is the English representative, for numerous valuable photographs and specimens, many of which are not referred to in the text, which have gone so far to make my necessarily curtailed description more interesting and intelligible.

APPENDIX.

Strength of Thermit Joint.

Tests made by Mr. F. S. MacGregor, Permanent Way Engineer, Leeds City Tramways.

June 23rd, 1903.

Rail supported five feet centre to centre, test made with 10 inch ram, 2 inch bearing on head of rail.

Up to 28 tons, no deflection and no set, and then 1-64 inch.

Up to 30 tons, 1-32 inch.
,, ,, 40 ,, 1-32 inch.
,, ,, 50 ,, 3-32 inch.
,, ,, 55 ,, 3-32 inch.
,, ,, 60 ,, 1-8 inch.

Test was then stopped, and it was found that there was no permanent set whatever.

Pressure brought on again to 65 tons, still only 1-8 inch deflection.

At 68 tons rail still sound.

" 70 " " broke, not through the weld.

7th July, 1903.

Hydraulic test. Dead load. Five feet bearings, 10 inch ram, 2 inch bar on head of rail.

85 tons ...... 3-16 inch set.

90 " ...... 1-4 inch set.

95 " ...... 1-2 inch and slight fracture.

Thermit welded joint tested to dead load as above. Up to 60 tons no permanent deflection. Safe dead load at 68 tons. 70 tons fractured at side of the weld, the welded portion remaining intact.

Fish and Sole Plate joint. Fish plates 62 lb. per pair, 2 feet long, six 1 inch bolts; sole plate 46 lb., 2 feet by 8 inch by $\frac{3}{4}$ inch, 12 $\frac{7}{8}$ inch bolts.

Permanent set at 85 tons $\frac{3}{4}$ inch.

" " 90 " $\frac{7}{8}$ inch.

Fractured at 102 tons.

J. S. MacGregor,
Permanent Way Engineer.

Comparative Resistance Tests Carried out by the Electrical and Permanent-Way Engineers to the Leeds City Council.

The following are the results of tests made of "Thermit" joints, a fish and sole plate joint, and the solid rail. The tests were made on the Headingly section, near Hyde-park-corner. The rail was disconnected at one end, so as to isolate the length containing the thermit and fish-plate joints, and the resistance was calculated from the voltage drop across each joint when a certain current was passing through it.

No. 1.—Rail with thermit welded joint with one bond 4/0 B. & S. Chicago type. This joint was made in February of this year, on a track that has been in operation since August 1898, and was not butt welded, there being an expansion space of 3-16 inch, and the rail packing underneath had given way, allowing the rail to vibrate as the cars passed over it.

No. 2 was the same joint, but with bond removed, and thermit joint only—not butt welded.

No. 3.—Our ordinary fish-plate and sole-plate joint: fish-plates, 2 feet long, 46 lbs. per pair, secured by six $\frac{7}{8}$ inch bolts; sole-plate, 2 feet by 8 inch by $\frac{3}{4}$ inch, and secured by twelve $\frac{7}{8}$ inch bolts and two 32 inch 4/0 B. & S. Chicago bonds. This joint was made in July, 1898.

No. 4.—Solid rail only on the same track.

No. 5.—Thermit welded joint where clamps had been used, and a butt weld secured. No special care taken at the making of this weld, and it may be taken as a fair sample of an ordinary thermit welded rail joint.

No. 1.—Resistance of 4 feet rail with thermit joint and one bond = ·0000533 ohms

No. 2.—Resistance of 4 feet rail with thermit joint and no bond —not butt welded .... = ·0000602 "

No. 3.—Resistance of 4 feet ordinary fish and sole plate joint with two bonds .... = ·0000578 "

No. 4.—Resistance of 4 feet solid rail only .... = ·0000339 "

No. 5.—Resistance of 4 feet thermit butt weld joint, no bonds .... = ·0000316 "

Signed,

John Burbridge, Chief Engineer.
J. S. MacGregor, P. W. Engineer.

November 15th, 1903.

DISCUSSION.

Mr. R. Inwards asked whether it was not possible in some cases to avoid the use of the crucible and melt the thermit round the joint itself.

Mr. C. E. Masterman thought it might be interesting to state that while at Leeds on the previous day he was informed by the manager of the tramway there that he had tried thermit for mending the main bar that ran under the car with perfect success. He was not able to show the work because the car was in use.

Mr. John Hall mentioned that he had welded in the United States a 7-ton fly wheel, and also in London a cracked shaft of 10½ in. diameter.

Colonel Allan Cunningham asked what was the longest length of continuous lines for trams in existence. There seemed to be a difficulty, owing to expansion, in the use of very long pieces. If one inspected the upright railings, such as those in Hyde-park, it would be found that the rails were laid out straight on the top of stone foundations and were leaded down at intervals, whereby the expansion was resisted; and after a hot summer he had often noticed that the rails were curiously curved; the stresses set up were so great as frequently to break the railing away from the foot where it was leaded into the stone. The very same thing could be seen in the railings in the front of ordinary dwelling-houses, the straight railings being distorted into curves in a hot summer, and very frequently broken away from the foot.

Mr. F. W. Fletcher asked if there was any firm in London which carried out repairs of machinery by the method described. He knew some firms in London, who had large rolling mills, where, if repairs could be done in the way mentioned, it would be a very valuable assistance.

Mr. A. P. TROTTER inquired what form of oxide iron was used.

Mr. J. W. SUTTON asked whether the welding of ls had been applied to the main lines of railways as ell as to tramways.

The CHAIRMAN thought that everyone who had ard the paper read, must have felt there were a num-r of applications for the beautiful system of welding scribed; but he was sorry to say he had observed e backwardness of Englishmen at present to adopt w inventions. It had lately been his duty to eside over a committee, the object of which was inquire into the rules that should be made for e use of electricity in mines, a very big subject, cause the mines of this country would soon electrified, coal cut by electricity, and a great nount of money invested in apparatus, which would ormously increase the output. First of all English gineers gave evidence before the committee, and was bound to say that, had the committee listened ly to them, a set of rules might possibly be formu-ted that would not have answered at all. But the mmittee discovered that in the Düsseldorf district e Germans were entirely ahead of this country the use of electricity in mines. Three-phase stems were being employed that were, he be-ved, partly invented by an Englishman, developed y a Swiss engineer, and worked out and practically pplied by the Germans. For instance, men and als were hoisted at a great rate from the pits ith electrically driven hoists and winding gear, hereas there was not a single electrically driven inding gear in the whole of this country; although, e was bound to say, on the other hand, there was three-phase coal-cutter in England which worked ithout any brushes, and consequently without parking, but only one. That was due to the nterprise of Mr. Garforth, the well-known nglish mining engineer; but on the whole England as distinctly behind Germany in that respect. Two xplanations occurred to him from his personal xperience of factories. In the first place, there was o great a disposition among all classes simply to muse themselves. The younger men, especially the ons of the owners, thought too much of golf and unting and too little of the details of their business. our great industries were to be conducted by aptains of industry of that sort, the sooner some hange took place the better it would be for the hole country. Again, there was too great a ten-ency, which was well known in engineering works, ot to write off a sufficient amount against deprecia-on of capital. There was not half enough machinery crapped, with the consequence that the machinery ecame antiquated. The second one was a deeper ne still—viz., that our education had been distinctly efective. It had been run on clerical lines. He did ot desire to say a word against clerical influence; it ad made England a moral nation; but, unfortu-nately, there was another side. A clerical master, when he saw a boy at a lathe, said: "What a useless thing it is; it amuses him, I suppose, poor fellow." In many schools a boy who ex-hibited any mechanical ability was looked down upon. When the Board schools were founded an attempt was made to copy the public schools system, and, even in the manufacturing districts, masters were appointed not one single one of whom knew how to handle a machine, with the result that boys who exhibited a tendency for mechanics and industry were discouraged, and everybody thought that the only thing worth knowing was how to spell correctly, or some rubbish of that sort. When one saw the rapid way in which the Germans, the Italians, and the Japanese picked up science, it made one feel that England must seriously wake up. Our commercial supremacy was threatened, but if the people of the country would only seriously take the mattter to heart he thought we should retain it. It was the young that had to be trained. The boys must be taught that life was not all "beer and skittles," and golf and bridge, but that they must take an intelligent interest in the commerce of the country. In every school where boys were trained for industrial pursuits an endeavour should be made to destroy the philosophical system of Aristotle, and substitute in their place the modern methods of learning science.

Mr. BOYS, in reply, said he was in perfect harmony with what the Chairman had said on the educational question. Mr. Inwards, who asked whether it was possible to use thermit without the crucible, had hit the nail upon the head, because in the most difficult operation to which he had referred, which was designed by Prof. Matthesius for welding new journals on rolls, the end of the roll was heated up by thermit ignited not directly upon its end, but in a crater so as to produce its heat without any intermediate waste *via* the crucible. But that could not be done as Mr. Inwards wished to do it for the reason that, in the first place, the temperature was inconveniently high. Not only was damage done to metal in immediate contact with the ignited thermit, but worse than that, the slag formed in minute quantities through-out the mass, had no time to be separated and cleared free from the thermit iron, the result being what was so graphically described by Dr. Percy, the famous metallurgist, in re-lation to another operation, as "a nasty mess." It could not be done directly by burning the thermit upon the material to be welded. He would not go through the whole of the details of Matthesius' beautiful process, but he had designed a method whereby the slag was collected on a cold ring and removed, and when the end of the roll had been brought up to the welding point, then steel from the ladle was tipped into the empty space, and so was welded on to the end of the roller by the intervention of the heat of the thermit

burnt there. He was glad to hear from one speaker that a 10½-inch shaft had been successfully welded in London. He had not heard of it before. Colonel Cunningham asked what was the total length of rails welded into one piece. The example Colonel Cunningham gave of the difficulty of welding long lengths into one piece was the very kind of example that he excluded when he spoke of tram-rails that were buried in the earth being distinct from the main line rails, which were exposed to the full blaze of the sun and the cold of the night alternately. The diurnal change of temperature did not occur in a rail which was buried seven inches in the ground; the stresses set up to make a movement and buckling were nothing like so great and often. Further, rails buried in the ground, which had the strength of concrete or wood paving to hold them there, were relatively much more strongly held than when let into stone curbs lying on bricks put together with London mortar; the circumstances were entirely different. It was known that in those cases the expansion of the straight length gave rise to trouble. He could not give an actual answer to Colonel Cunningham's question, but he could give what was equivalent to an answer—it did not matter whether it was a mile or a thousand miles, for this reason. If there was a straight length of tram-rail buried in the ground, there were numerous cross-bars and the shoes described all carefully concreted into the ground. The actual amount of adhesion between the rail and the ground was so great that when expansion occurred on a very great length of rail all except what must be called the free end was locked to the ground and could not move. Up to within the last 30 or 50 yards the forces were sufficient to prevent the rail moving. The free end at each end was subject to expansion, but not very much, but all between was absolntely held to the ground; and unless it broke, it would not, in any way, suffer from expansion and contraction. That also was an answer to the question about the main lines. Main lines were exposed to the sun, where the day heat might be very great, as a fact a rail could not be touched when the sun was on it. Further the rail was only held by chairs and sleepers; and the adhesion between the rail and the ground was much less in that case than in a tram-rail with its concrete and paving; so that there were enormously greater forces set up from change of temperature, and enormously less power of controlling those forces because of the very feeble adhesion of the rails and sleepers to a gravel bed as compared with the concrete of the street paving. Main lines exposed to the air had not been welded. He had been asked whether it was possible to get welding done in London. He referred the speaker to Mr. Masterman, of Victoria-street, the London representative of Dr. Goldschmidt. Mr. Trotter asked what oxide of iron was used. At one time he believed that ordinary brown oxide of iron was used, but that brown thermit was not now sent from Germany. The whole of the thermit was made i[n] Germany. The English patent-law was a beautif[ul] system. A foreigner made an article under th[e] protection of English patent-law, not because h[e] could make it cheaper or better, but because of th[e] protection of the patent-law; and thermit wa[s] made in Germany, under the protection of th[e] patent-law, to the advantage of the German. The German deserved the advantage, because he sa[w] the value of the invention when nobody in Englan[d] would see it; but he would rather the English paten[t] law did not allow him to do it, but compelled him t[o] send intelligent people over to this country to manu[]facture and to teach us all that we could learn fro[m] them, and also that we might go on making goo[d] Germans into good Englishmen. As far as he kne[w] any oxide of iron would do; from looking at it h[e] judged that forge scale would do perfectly wel[l]. What Dr. Goldschmidt actually used he took ver[y] good care that nobody should know.

On the motion of the CHAIRMAN, a vote of thank[s] was passed to Mr. Boys.

Miscellaneous.

*LEAD ARCHITECTURE.**

The direct purpose of the scholarly and inspirin[g] paper on "Lead Architecture" recently read b[y] Mr. Starkie Gardner before the Royal Institute o[f] British Architects was to advocate the larger us[e] of lead, not only in the decoration, but in the con[]struction of buildings, both private and public; bu[t] it also, indirectly, suggests a reference to the salien[t] statistical facts of the present position of the pro[]duction and manufacture of lead in this countr[y] which are full of cautions for all those who ar[e] anxious to cast a right and true vote on the grea[t] fiscal question now before this country; and to thes[e] figures I would desire, very briefly to call attention for they deserve the most searching and deliberat[e] consideration.

It is not necessary to go into any ancient, c[l] mediæval, or modern history to show our continuou[s] pre-eminence from time to time when, according t[o] Pliny [vii., 56, (57)], "Plumbum† ex Cassiterid[e] primus aportavit Midacritus" [*i.e.*, the Phœnicia[n] "Melkart"] down to the XIXth century in th[e] export of lead and leaden wares. Nearly all th[e] older French churches and palaces were covered i[n] with British lead; and Louis XIV. used "32,000,00

* This article by Sir George Birdwood, K.C.I.E., is re[]printed from *The Builder*.

† Plumbum here means "lead," or includes lead, Plin[y] distinguishing tin ore as "p: caudidum" and tin in bars a[s] "stagnum,"—after IVth century A.D. "stannum" [xxxiv 16, (47)], the *Kassiteros* of Homer, Assyrian *Kazasatir*[a] Accadian *Kasdura*, and Sanskrit *Kastira*. Compa[re] "Casiter St." Bodmin!

" of "English lead" on the roofing of illes. The catastrophic decline in the pro- on of British lead began late in the XIXth ry, and during the last thirty years has continued rate which seems to threaten its extinction in er decade or two. Thus the production was :—

1877	80,850 tons.
1887	52,563 ,,
1897	35,338 ,,
1902	24,606 ,,

r some time previous to this decline the pro- on was not equal to our consumption of lead; s diminution is not to be traced to any exhaustion r lead mines, and is to be attributed for the part to the comparative cheapness with which was, and still is, worked in other countries— , United States of America, New South Wales, h Australia, etc.; the total imports of lead ore, ead, and sheet lead into the United Kingdom other countries having amounted in 1902 to 44 tons, as against our output, as shown above, ,606 tons. In the same year our exports of n lead ore, pig lead, and sheet lead amounted to 2 tons; and of British lead ore, pig lead, sheet and lead piping and lead tubes—some of which es were, I presume, manufactured of foreign -to 34,987 tons; thus leaving an immense e for home consumption. The fall in the price d is shown in the following figures :—

	£	s.	d.	
73	23	6	0	per ton.
3	12	18	0	,,
3	9	16	11	,,
2	11	4	8	,,

w, although our mines are not exhausted, the ction of them could not have been raised to the ndous proportions of the importations of foreign and without the cheapening of lead caused by foreign importations there would have been no bility of the extended and in every way highly tageous use of lead that has been followed in ountry during the last thirty years, and no possi- of its yet wider application in architecture as sed by Mr. Starkie Gardner; or, in other words, e restoration of lead to its proper place in the ecture of this country, where lead was intimately ated with the whole scheme of our domestic ocial life long before the building of our dwellings een developed into the master art (as it is for country) of all its truly national and idiosyn- arts. Man does not live on bread alone; and st not be overlooked, in the consideration of the ion now before the voters of this country, that vival of the arts of this country during the reign een-Empress Victoria was profoundly influenced Free Trade" and free popular intercourse with Continent, and the free immigration into this ry of "undesirable aliens."

course, to restore prosperity to our actual lead in Cornwall, Flint, Cardigan, Derbyshire, Durham, Cumberland, Westmoreland, etc. (the Isle of Man has suffered nothing from the competition of the foreigners), there would be nothing like raising the price of lead again, by means of a duty on imported lead, to £20 a ton; and by the lead we then took of the foreigner the whole nation would benefit to the extent of the duty paid on it. But is the inevitable decay in the spiritual life of the country which would follow on the adoption of anything like a general "protective" tariff to count for nothing? I am advancing no plea, but simply emphasising one of the several cautions forced on me by the reading of Mr. Starkie Gardner's illuminating paper.

As to its its immediate object, I would fain be permitted to add that lead readily conducts heat and cold; a fact which made "the leads of Venice"—the prisons in the roof of the Ducal Palace of St. Mark—proverbial throughout Europe by reason of their frightful heat during the months of summer. But lead might well be used for winter gardens, orangeries, riverside residences subject to flooding, bridges, fountains, and statues of the indicative class, such as the archer at one time placed in front of, or over the entrance to military barracks—whence such phrases as [*Othello* I., 1] "lead to the Sagittary."

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock :—

FEBRUARY 17.—"Garden Cities in their relation to Industries and Agriculture." By A. R. SENNETT. THE EARL OF DENBIGH will preside.

FEBRUARY 24.—"Mahogany and other Fancy Woods available for Constructive and Decorative Purposes." By FRANK TIFFANY.

MARCH 2. — "Physical Degeneration." By ROBERT JONES, M.D., B.Sc., F.R.C.S. SIR WILLIAM CHURCH, Bart., M.D., P.R.C.P., will preside.

MARCH 9.—"Mechanical Piano Players." By J. W. COWARD.

MARCH 16. — "Artificial and other Building Stones." By L. P. FORD.

INDIAN SECTION.

Thursday Afternoons, at 4.30 o'clock :—

MARCH 10.—"China Grass: its Past, Present, and Future." By FRANK BIRDWOOD, B.A. PROF. SIR WILLIAM RAMSAY, LL.D., F.R.S., will preside.

COLONIAL SECTION.

Tuesday afternoons, at 4.30 o'clock :—

MARCH 1.—"Nigeria." By LADY LUGARD (Miss Flora L. Shaw). The DUKE OF MARLBOROUGH, K.G., Under-Secretary of State for the Colonies, will preside.

APPLIED ART SECTION.

Tuesdays, at 4.30 or 8 o'clock :—

FEBRUARY 18 (THURSDAY). — Visit to the *Graphic* Printing-office by invitation of the Proprietors. 8 p.m. to 10.30 p.m.

CANTOR LECTURES.

Monday evenings, at 8 o'clock :—

J. LEWKOWITSCH, PhD., M.A., F.I.C., "Oils and Fats—their Uses and Applications." Four Lectures.

LECTURE IV.—FEBRUARY 15.—Modern Processes of Saponification—Candle Industry—Soap Industry —Manufacture of Glycerine—Recovery of Glycerine from Soap Lyes.

CHARLES T. JACOBI, "Modern Book Printing." Two Lectures.

LECTURE I.—FEBRUARY 22.—*Printing Types.*—Some account of those used by the early and subsequent Printers—Founts specially designed for the private Presses of the present day — Some good Types that may be obtained in the open Market, well adapted for the different classes of Book Printing—The choice of a suitable Type.

LECTURE II.—FEBRUARY 29.—The Details of Composition—The Formation of the Page—Margins —Paper—Ink—Presswork—Title Pages – Some conclusions.

BERTRAM BLOUNT, F.I.C., "Recent Advances in Electro-Chemistry." Three Lectures. March 7, 14, 21.

The following course will be delivered on Monday afternoons, at 4.30 o'clock :—

PROF. R. LANGTON DOUGLAS, M.A,, "The Majolica and Glazed Earthenware of Tuscany." Three Lectures.
April 25, May 2, 9.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, FEB. 15...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Dr. J. Lewkowitsch, "Oils and Fats—their Uses and Applications." (Lecture IV.)

British Architects, 9, Conduit-street, W. 8 p.m. Prof. F. Clowes, "The Bacteriological Disposal of Sewage from Isolated Buildings."

Medical, 11, Chandos-street, W., 8½ p.m.

London Institution, Finsbury-circus, E.C., 5 p.m. Rev. Canon Benham, "Names and Surnames."

TUESDAY, FEB. 16...Royal Institution, Albemarle-street, W., 5 p.m. Prof. L. C. Miall, "The Development of Animals." (Lecture VI.)

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Mr. Alphonse Steiger, "The Forms of Turbines most suitable for Low Falls."

Statistical, 9, Adelphi-terrace, W.C., 5 p.m. Mr, E. L. Hartley, "Trade Union Expenditure on Unemployed Benefit."

Pathological, 20, Hanover-square, W., 8½ p.m.

Photographic, 66, Russell-square, W.C., 8 [illegible] Lantern Meeting.

Zoological, 3, Hanover-square, W., 8½ p.m. 1. [illegible] Cyril Crossland, "The Marine Fauna of Zanz[illegible] and British East Africa.—Polychæta, Part I[illegible] 2. Mr. Cyril Crossland, "The Polychæta of [illegible] Maldive Archipelago from the Collections m[illegible] by Mr. J. Stanley Gardiner in 1899." 3. [illegible] Charles Eliot, "Some Nudibranchs from Zanz[illegible] and East Africa.—No. IV. Dorididæ Cry[illegible] branchiatæ."

Colonial Inst., Northumberland - avenue, W[illegible] 4 p.m. Annual Meeting.

WEDNESDAY, FEB. 17...SOCIETY OF ARTS, John-st[illegible] Adelphi, W.C., 8 p.m. Mr. A. R. Sen[illegible] "Garden Cities in their Relation to Indus[illegible] and Agriculture."

Meteorological, 25, Great George-street, S.W[illegible] p.m. 1. Mr. Edward Mawley, "Report on Phenological Observations for 1903." 2. Mr [illegible] H. Dines, "Observations by means of Kite[illegible] Crinan in the Summer of 1903."

Chemical, Burlington-house, W., 5½ p.m. 1. [illegible] R. J. Friswell, "Observations on some Contin[illegible] Intramolecular and at first Reversible Cha[illegible] extending over prolonged Periods of Time." [illegible] Mr. A. McKenzie, "The Esterification [illegible] Mandelic Acid by Menthol and Borneol."

Microscopical, 20, Hanover-square, 8 p.m. 1. [illegible] E. M. Nelson, "The Vertical Illuminator, and [illegible] Influence of the Antipoint on the Microsc[illegible] Image shown Graphically. 2. Mr. Keith Lu[illegible] "A Microscope with Geometric Slides." 3. [illegible] C. L. Curties will Exhibit Specimens of M[illegible] Objects, mounted by Mr. H. J. Waddington.

United Service Institution, Whitehall, S.W., 3 [illegible] Colonel E. W. Cotter, "Coast Defence from [illegible] Imperial Point of View."

British Archæological Association, 32, Sack[illegible] street, W., 8 p.m.

Silk Association (at the HOUSE OF THE SOCIETY [illegible] ARTS), John-street, Adelphi, W.C., 3 p.m. An[illegible] Meeting.

THURSDAY, FEB. 18...Royal, Burlington-house, W., 4½ [illegible]

Antiquaries, Burlington-house, W., 8½ p.m.

Linnean, Burlington-house, W., 8 p.m. 1. [illegible] R. H. Biffen, "'Mendel's Laws, as Illustrate[illegible] Wheat Hybrids." 2. Mr. W. Bateson, "Her[illegible] and Variation, as seen in *Primulæ Sinen[illegible]* 3. Mr. L. A. Boodle, "Formation of Secon[illegible] Wood in *Psilotum*."

Royal Institution, Albemarle-street, W., 5 [illegible] Mr. A. D. Hall, "Recent Research in Agr[illegible] ture." (Lecture III.)

Optical, 20, Hanover-square, W., 8 p.m. [illegible] by Mr. L. D. Chalmers.

Historical, Clifford's Inn Hall, Fleet-street, [illegible] 5 p.m. Annual Meeting.

Numismatic, 22, Albemarle-street, W., 7 p.m.

FRIDAY, FEB 19...Royal Institution, Albemarle-street [illegible] 9 p.m. Mr. C. T. R. Wilson, "Condens[illegible] Nuclei."

Architectural Association, 9, Conduit-street, [illegible] 7½ p.m. Mr. W. H. White, "Corner Houses[illegible]

Quekett Microscopical Club, 20, Hanover-sq[illegible] W.C., 8 p.m.

Geological, Burlington house, W., 3 p.m. An[illegible] Meeting.

SATURDAY, FEB. 20...Royal Institution, Albemarle-street [illegible] 3 p.m. Lord Rayleigh, "The Life and Wo[illegible] Stokes." (Lecture I.)

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FRIDAY, FEBRUARY 19, 1904.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

NEXT WEEK.

Monday, February 22, 8 p.m. (Cantor Lecture.) Charles T. Jacobi, "Modern Book Printing." (Lecture I.)

Wednesday, February 24, 8 p.m. (Ordinary Meeting.) Frank Tiffany, "Mahogany and other Fancy Woods available for Construction and Decorative Purposes."

Further details of the Society's meetings will be found at the end of this number.

CANTOR LECTURES.

Dr. J. Lewkowitsch delivered the fourth and last lecture of his course on "Oils and Fats" on Monday evening, 15th inst.

A vote of thanks to Dr. J. Lewkowitsch for his valuable course of lectures was carried on the motion of the Chairman.

The lectures will be published in the *Journal* during the summer recess.

SUPPLEMENT TO THE JOURNAL.

With this number of the *Journal* is issued a Supplement, containing Tables A to D of Mr. Sennett's paper on "Garden Cities," relating specially to Beet Cultivation in England.

COVERS FOR JOURNAL.

For the convenience of members wishing to bind their volumes of the *Journal*, cloth covers will be supplied, post free, for 1s. 6d. each, on application to the Secretary.

Proceedings of the Society.

COLONIAL SECTION.

Tuesday afternoon, February 9th, 1904; The Right Hon. James Bryce, M.P., D.C.L., LL.D., in the chair.

The Chairman said the subject upon which Sir John Cockburn had undertaken to speak was of the highest possible interest. The author of the paper had filled posts of high distinction and importance in the colony to which he belonged, and had subsequently been its Agent-General in England, and was, therefore, conversant, not only with the condition of Australia, and with Colonial problems generally, but was also able to look upon them from the point of view of an English statesman. Sir John Cockburn belonged to the class, unfortunately too small, of those who brought to the study of problems in politics and practical sociology the experience of a scientific and professional training; and the very subject which he had chosen for his paper indicated that, as a former student of medicine and of science, he was able to look at those social and political problems from the scientific point of view, and to see how much of analogy there was between the life processes which went on in living organizations within the field of biology proper and the life processes which went on in political organizations and institutions. This analogy had floated before the minds of political thinkers for many generations past; but as of late years science had been studied so much more exactly, and its methods had been perfected, it (the analogy) had become more interesting and instructive than formerly. Federations were a form of political organisation of the greatest significance. He read the other day in the work of one of our wisest and most learned writers upon politics, the late Mr. Henry Sidgwick, the remark that federal schemes of government were likely, for the future, to play an increasingly important part in the evolution of free institutions. Till the middle of the last century the only federation in the world was that of the United States of North America, itself only dating from 1788. Since then four new ones had been created, first the Swiss Confederation—because the old Swiss League was not turned into a regular federation until the middle of last century—then the Canadian federation; then the German Empire, which, although a monarchy, was also a federation; and last of all, there came the federation of Australia. We had, therefore, now at hand far more ample materials for investigating what might be called the natural history of federal Governments, the sources of their strength, and the maladies to which they were liable than were in the possession of any earlier generation of mankind.

This was the subject which (as he understood) Sir John Cockburn proposed to treat, and which he would treat with the double advantage of first-hand knowledge of the phenomena attending the creation of confederation in Australia, and the skill of a scientific observer who had been accustomed to apply scientific methods during the whole of his life. Though neither the audience nor he had yet heard the paper, he would venture to say two things in regard to one of the topics which he understood the paper dealt with, viz., the possibilities of attaching the Colonies to the Mother Country, by a permanent tie, of a quasi federal scheme of government. His first remark was that the object was one upon which there was no difference of opinion in Great Britain. Every political party, indeed every section of a party, desired that the connection between the United Kingdom and her Colonies should, in every successive generation, grow stronger, closer, and more durable. All English men were proud of the growing sentiment of attachment they discerned in the Colonies, and all felt that the sense of interest in the Colonies which had never quite failed in England, had, within the lifetime of the present generation, become much warmer than formerly it was. There was a time when it was supposed that the Colonies would naturally drop away, and the familiar metaphor of the fruit dropping off the tree when it was ripe was used, as metaphors often were, to convey an entirely false prediction. Those days of comparative indifference had happily now passed away, and they all desired to do everything they could to make the connection closer and more durable. The other observation he desired to make, was that they must be careful in such a matter to be guided mainly and primarily by the views and wishes of the Colonies themselves. Twenty years ago he was one of the first members of the Imperial Federation League; and there was borne in upon him, in the course of the discussions of its Committee, as to the means of devising a constitution to unite the United Kingdom and the Colonies (and it had been borne in upon him since in conversing with many Colonial statesmen upon the subject), that they must allow the colonists to have the first and chief voice in settling matters of the kind; and however warm their desires might be for endeavouring to draw closer the ties which united them with us, we must beware of doing anything which could disturb the well-founded security in which the Colonies had hitherto rested, that there was no intention on the part of the Mother Country to circumscribe their self-government, no desire to impose upon these great communities anything which would check or disturb the political and social development of each of them on its own lines, in the way it found best for itself. That was the view he had gathered from what every Colonial statesman had told him; and, therefore, while feeling hopeful with regard to the future, and while believing that the process of discussion would, by degrees, work out some method or device by which the Colonies would be brought to a better defined constitutional relation he thought they must not make any hasty attempt to change the present state of things. The United Kingdom and the Colonies were as a matter of fact in perfectly close and good touch with one another. They knew that we did not desire to interfere with their self-government; and they, on the other hand, showed themselves more and more willing to be helpful to the Mother Country as opportunity might offer for them to do so. It was probable that they might contribute more largely than they had yet done to imperial defence. Therefore, it was not to be supposed that there existed any urgent need for the creation of a new governmental system. Under our present system we were working smoothly and happily. When any opportunity presented itself by which a means could be devised of giving us at home a fuller means of ascertaining their sentiments upon any current question of imperial interest, or associating them with us in the work of imperial defence, and in all other matters which the Mother Country and the Colonies had in common, by all means let such an opportunity be promptly used. Much must depend upon the course which events take. The secret of success was in seizing opportunities as they came. If the minds of statesmen are steadily bent upon this excellent and admirable aim, if they endeavour to find a place which colonial opinion will approve, the opportunities that are pretty sure to arise might be so handled as to promote the consolidation of the British Empire, and, therewith, the peace of the world. As he was, to his great regret, obliged to leave before the end of the reading of the paper, he would take this opportunity of expressing the pleasure they all felt that a man so eminent as Sir John Cockburn, and possessing so exceptional an experience, was good enough to come and state his views upon a question which had scientific interest as well as practical importance.

[During the reading of the paper the chair was vacated by Mr. Bryce, when his place was taken by Sir Westby B. Perceval, K.C.M.G.]

The paper read was

THE BIOLOGY OF FEDERATION.

By the Hon. Sir John Alexander Cockburn, K.C.M.G.

When about fifty years ago English statesmen were, by all means in their power, facilitating and inducing the separation of the Colonies from the Mother Country, little did they think that as instruments in the hands of evolution they were doing just the reverse of what they intended, and instead of officiating, as they thought, at the euthanasia of the Colonial Empire, they were in reality providing for the

birth of a firm, flexible and efficient Federal Union. The laws of evolution were at that time almost a sealed book, and few were aware that the forces that tend towards separation, and those that make for union, are equally necessary factors in the process of development. A flood of light has been thrown on the growth of societies by the recognition that they are subject to laws analogous if not identical with those that govern the development of living beings, and many phenomena which formerly appeared paradoxical and contradictory, have thus been explained and reconciled. Auguste Comte thought that a study of the laws of life, that is of biology, was necessary for the proper comprehension of sociology; in his opinion "the leading principles of biology will always be regarded as stepping stones to the fundamental conceptions of sociology." Comte's method of investigation was by sociological suggestion and biological proof, and a singular example of the value of this sequence is found in the fact that Darwin obtained the clue to his great discoveries from contemplating a social problem. Herbert Spencer, in his massive "Synthetic Philosophy," elaborates the numerous points of agreement between the two sciences. Sir Leslie Stephen speaks of the community as a social tissue, and a general agreement as to the organic nature of society is summed up in the current use of the phrase, 'The Social Organism." In biology the forces that tend towards separation and union are known respectively as differentiation and integration, and every living creature and every society, in ascending the scale of evolution, is subject to the simultaneous or alternate operation of these forces. For continuous growth and development, a nice adjustment of the two apparently antagonistic but really complementary forces is necessary. Each may preponderate for a time, but neither should exercise unremitting sway. The rule is that the greater the degree of separation, provided the integrating force is sufficient to hold all together, the more complex and the higher the order of the organism. In the highest animals the body is differentiated into organs and limbs which co-operate to the manifest advantage of the whole organism. The human arm and hand may be taken as an illustration of the advantage which accrues to an organism by differentiation and partial separation. The arm makes its first appearance as a little projection presenting no difference of parts. This projection becomes elongated and more and more distinct from the rest of the body, from which when fully developed it is completely detached except at the ball and socket shoulder joint—thus through separation the limb acquired a degree of mobility which enables it to subserve the purposes of the whole body far better than if the separation had been less marked. Then again the wide separation of the thumb from the other digits, enabling it to co-operate with each and all of the fingers, characterises the marvellous mechanism of the human hand, and ensures the supremacy of the lord of creation as a tool-using animal. In a highly-organised body the members may be said to undergo a partial separation in order that they may become more intimately and to better purpose united. We can readily see, in the light of after events, how in strict accordance with the laws of biology the separation movement of last century ministered to the necessities of the higher evolution of the Empire. Without the freedom of movement due to partial detachment the colonies would have always been in leading strings and would have remained mere dependencies. They could not have gained the self-reliance, initiative, and individuality essential to the full stature of nationhood. Nor would Greater Britain ever have reached the threshold of the unparalleled and unbounded prospect which lies before the united nations of the Empire—the parent in partnership with adult virile sons in every quarter of the globe, under every variety of climate and calling—a veritable brotherhood of manifold diversity, harmoniously co-operating for the common welfare and advancement of the race.

The original unit of life is the simple cell, which multiplies by sub-division. All living things are divided into two classes, the protozoa or single celled, and the metazoa or many celled. In the protozoon, which is the lowest form of life, sub-division implies complete separation of the progeny from the parent, the integrating force being insufficient for the maintenance of relationship. Whereas in the metazoon sub-division does not involve separation. The off shooting cells remain in more or less close relation with one another, and may assume different functions. The protozoon is homogeneous in structure, there are no different parts, the whole cell performs indifferently the functions of sensation, locomotion, and digestion. It is, in a rudimentary sense, all eye, all limb, all stomach—and may be called a feeble jack of

all trades. On the other hand, in the many celled entities, there is, as it were, a division of labour; the various groups of differentiated, but not wholly detached, cells undertake different duties, enter into definite relations, and become regularly co-ordinated in the performance of the functions necessary for the common life.

The process of evolution is the same, whether it deals with the primordial cell, which by sub-division forms the various tissues and organs which, grouped together, constitute a complex organism, or whether it deals with a primitive homogeneous society, which by division of labour and co-ordination of effort, becomes a civilised community, and by combination with other communities a nation; or whether, on the highest plane of all, it deals with a race which, by colonisation and subsequent co-operation of its several parts, becomes an Empire.

Primitive societies may be regarded as analogous to the simple cell. They are homogeneous, there is no division of labour; the whole community engages alike in warfare, industry, or production. Such rudimentary societies are full of vitality, but fall an easy prey to more complex and effective organisations. If from one of these simple societies an off-shoot takes place, the separation is complete. The faculty for associated action is insufficient to provide for a continuance of relationship. Even in such advanced civilisations as those of ancient Greece, colonisation implied complete separation. The unit of government was incapable of permanently expanding beyond the limits of a single City, which was supposed to be confined to the compass of a herald's voice. There was no machinery capable of securing co-ordination between the mother and daughter States; although, under stress of the necessity for combined defence, temporary alliances, and even more or less lasting confederations, such as the Achaian League, were formed. The Greek State, therefore, so far as colonisation was concerned, got no farther than the methods of the protozoon. With every facility for separation there was a lack of the integrating power necessary for the formation of a widely-extended and complex social organisation. The cohesive forces were not sufficient for sustained co-ordination, and those bright, but limited, centres of the arts and philosophy fell a prey to nations endowed with wider integrating capacity. In the case of Rome, the conditions were reversed; her colonies knew no independent life—they were essentially military settlements in subordination to the central authority. They lacked the power of adaptation to diverse conditions. The integrating power was far in excess of the capacity for variation, and the Roman Empire may be said to have fallen a victim to the perfection of its system.

It is the tendency towards variation that provides for adaptation to the ever-changing requirements of progressive ages. Without some departure from type, there can be no advance, no improvement. Nature is an inveterate projector and speculates in every kind of novelty, but has abundant resources to make good all losses. At the roaring loom of time, innumerable patterns have been set up for the moment, only to be as instantly discarded. Selection, Nature's foreman, steps in, and applying the test of fitness to all innovations inexorably dooms to extinction those that are not immediately useful, otherwise an unlimited fertility in design would convert creation into a chaos of fantasy. In every organism which is fitted to progress, the tendency to variation and to preservation of type must exist in due proportion. If the tendency to difference preponderates, and is insufficiently balanced by the unifying force, the result is complete sub-division or dissolution of the organism. If on the other hand the capacity for differentiation is overpowered by the integrating influence, further progress is checked, and the organism lapses into the impasse of arrested development. Just as in the solar system an excess of the so-called centrifugal force would drive the planets aimlessly from their orbits into space, and an excess of the centripetal force would terminate their career as distinct entities by precipitating them into the sun.

The phases of separation and union correspond to autonomy and central control. These conditions were at one time regarded a antagonistic and incompatible, but just as in biology the former were found to be complementary and consistent, so in the federal form of Government the latter are reconciled. All are agreed that the larger the body the more varied and complex must be the organisation necessary for effectual existence. Mere increase in size without increased complexity of structure and differentiation of parts makes bodies sluggish, and unable with sufficient rapidity to re-act on the conditions to which they are exposed. This accounts fo

the displacement of antediluvian monsters by the more highly organised and alert carnivora. The evolutionary problem with which, in the present age, the Empire is confronted, is to provide for the world-wide British possessions an organisation sufficiently elastic to permit the full play of the British genius for self-government, and yet, at the same time, sufficiently co-ordinated for mutual purposes. In widely-extended social organisms the federal form best fulfils these conditions, for in it the forces of difference and union can be more easily harmonised than in any other.

In a federation the greatest freedom in local and national affairs is combined with the strength springing from united action for defence and with the efficiency of joint management of common services. A huge territory like that of the British Empire, embracing every variety of climate and circumstance, could never be sufficiently animated from a single legislative centre, nor could any system of laws be applicable to such contrasted conditions as those which obtain in the self-governing colonies and in India, the form of government required in these cases being entirely different, and laws that are good for the one are bad for the other.

Never in the world's history was a territory so mapped out for a modern federation as is Greater Britain. The due bounds between external and domestic affairs were drawn by Nature's finger when the ocean frontiers were aligned. The elements conspired at the proper time to effect the necessary differentiation, and the invention of steam and electricity have joined hands to bring about the re-attachment which is now taking place. Had the present rapid means of communication existed in the middle of last century the old colonial system could hardly have been abolished. The ocean which divided the various members of the Empire when the wave of separation was essential now forms the connective tissue which unites the organism.

M. Leroy Beaulieu, in his book on "The New Anglo-Saxon Societies," makes some remarks on this subject, which evince remarkable penetration into the problem of Imperial Federation. He writes :—

"The British Empire is the most vast that has ever existed; its area is three times that of Europe, and covers more than one-fifth of the dry land of the globe, leaving far behind the enormous territories occupied by Russia, China, the United States and Brazil. Its population is probably somewhat under that of the Celestial Empire, but includes not less than a quarter of the human race. No doubt the countries subject to the British sceptre are dispersed in every quarter of the world, instead of forming compact masses like the countries mentioned above or the great empires of antiquity. But this lack of cohesion is more apparent than real. The means of communication have become so rapid in our day that less than a month suffices to travel from one point to another of the British Empire, however distant. Longer was assuredly needed to traverse the Empire of Rome eighteen centuries ago, and still longer is necessary to pass to-day from one extremity of the Russian Empire to the other. Does anyone aver that the necessity of crossing the sea to traverse the British possessions is a source of weakness to this immense dominion? But is not the very ocean Britannic according to every good Briton when he justifies the maintenance of the strength of the British fleet? Far from separating them the ocean is the tie which unites the scattered members. Great Britain is, in a sense, at home upon the highways of the deep which lead to her dependencies. She could prevent other States from communicating with their own, or, at least, could throw a thousand difficulties in their way. It is this which is the essential characteristic of the British Colonial Empire. Its metropolis is mistress of the seas; the communication between its several parts is as assured under all circumstances as if they formed a continuous territory."

Countries are now less severed by water than by some tracts of land. For example, the real southern boundary of modern Europe is not now, as formerly, the northern shore of the Mediterranean, but rather the northern edge of the desert of Sahara. The contrast between mediæval and modern communications is illustrated by the statement that the news of Queen Elizabeth's death did not reach some parts of Devonshire until after the Court was out of mourning, whereas the message announcing the death of Queen Victoria outstripped the sun.

One extraordinary circumstance connected with the working of these evolutionary laws that so closely concern our existence and destiny is that their operation takes place outside the ken of our consciousness. Nature is chary of entrusting to human intelligence the control of organs necessary to the preservation of life. The functions of circulation, digestion, and respiration are exercised involuntarily, and to rivet the attention upon them cannot assist, but may embarrass, the process; and it was not to be expected that less care would be taken to guard from unwise interference the highest functions of sociological evolution, which at

certain stages are best performed when free from molestation. Thorold Rogers writes of the American colonies in their early history as thriving under the "beneficent neglect" of the Home Government.

We perceive the facts of evolution, but are often ignorant of their significance. Our intelligence is a lantern to our feet, but, does not reveal the goal towards which our pathway tends. As Professor Seeley says :—" We seem, as it were, to have conquered and peopled half the world in a fit of absence of mind." This unconscious working out of Nature's plans, is, however, no strange matter to the biologist. He is well aware of the jealousy with which the goddess guards her secrets. The keenest investigator of Nature's mysteries has often to be content to sail with sealed orders, and only discovers his destination when far advanced on his voyage. The pioneers of some of the greatest movements the world has ever witnessed were unaware when they set out where their course would land them. Never was the great truth that "there's a divinity that shapes our ends, rough-hew them how we will," better illustrated than by the frustration of the efforts of the pilots who laid down in the middle of the last century the parting of the ways in the imperial course.

Although the Whigs, in consequence of their traditional policy of *laissez faire*, were supposed to be specially inclined to cut the colonies adrift, there does not seem to be much to choose between the attitude of the great historical parties in this respect. Many of the leaders seem to have shared the opinion of Turgot that colonies are like fruits which cling to the tree only till they ripen. Lord Elgin, in a letter to Lord Grey dated 23rd March, 1850, thus alluded to a speech of Lord John Russell in the House of Commons :—

"On this solemn occasion the Prime Minister of England, amid the plaudits of a full Senate, declared that he looked forward to the day when the ties which he was endeavouring to render so easy and mutually advantageous would be severed . . . . But wherefore then this anticipation ? . . . . Because Lord John and the people of England persist in assuming that the colonial relation is incompatible with maturity and full development. And is this really so incontestable a truth that it is a duty not only to hold but to proclaim it ? . . . . You must renounce the habit of telling the colonies that the colonial is a provisional existence. You must allow them to believe that, without severing the bonds which unite them to Great Britain, they may attain the degree of perfection, and of social and political development, to which organised communities of free men have the right to aspire."

And with an appreciation of the position which to-day is as just as at the time it was written, Lord Elgin thus continues :—

"Is not the question at issue a most momentous one ? Is the Queen of England to be the sovereign of an Empire, growing, expanding, strengthening itself from age to age, striking its roots deep into fresh earth, and drawing new supplies of vitality from fresh soils ? Or is she to be for all essential purposes of might and power, monarch of Great Britain and Ireland merely—her place and that of her line in the world's history determined by the productiveness of 12,000 square miles of a coal formation, which is being rapidly exhausted, and the duration of the social and political organisation over which she presides dependent on the annual expatriation, with a view to its eventual alienation, of the surplus swarms of her born subjects ?"

At an earlier date, Lord Durham uttered the following protest against the current view :—

"The experiment of keeping colonies, and governing them well, ought at least to have a trial ere we abandon for ever the vast dominion, which might supply the wants of our surplus population, and raise up millions of fresh consumers of our manufactures, and producers of a supply for our wants."

The attitude of the Colonial Office on this momentous question may fairly be gathered from the views of Sir Henry Taylor ; views which, during his long connection with the department, doubtless derived their colour from some of his official chiefs. In a letter to the Duke of Newcastle, in 1864, he says :—

"As to our American possessions, I have long held and often expressed the opinion that they are a sort of *damnosa hæreditas* ; and when your Grace and the Prince of Wales were employing yourselves so successfully in conciliating the colonists, I thought that you were drawing closer ties which might better be slackened, if there were any chance of their slipping away altogether. I think that a policy which has regard to a not very far-off future, should prepare facilities and propensities for separation. In my opinion, the worst consequence of the late dispute with the United States has been that of involving this country and its North American provinces in closer relations and a common cause. I should desire to throw the current military expenditure upon the colonists, as tending by connecting self-protection with self-government, to detach the Colonies and promote their independence and segregation at an earlier day, and thereby to withdraw this country in time from great contingent dangers."

The great boon of autonomy appears to have been granted more from motives of convenience to the parent than from regard for the welfare of the offspring, and was admittedly conceded with the belief that it would facilitate separation. In spite of the ample evidence of a timorous reluctance on the part of politicians in the mother country to bear the responsibility of her colonial progeny and Malthusian regrets as to their number, the people themselves never seem to have shared these niggardly views. Instinct is often a truer guide than reason. Natural affection has a way of rising superior to the cold-blooded abstractions of statesmen, and it is probable that at no time would the country at large have viewed with any feelings but those of repugnance the design of severing the ties of relationship with the colonies. Certainly, at several crises in our history, popular opinion has had a truer appreciation of Imperial requirements than was revealed to the supposed leaders. For example, it was popular sentiment that insisted upon the expedition for the relief of Gordon, who had been sent out to withdraw the garrisons and abandon the occupation of the Soudan; and who, like Sir George Grey and others, may be said to have been organically right even although departmentally wrong in his action.

The seeds of indifference so studiously scattered could not fail to secure some lodgment and roothold in the colonies. And up to quite recent years there was an absence of enthusiasm with regard to the Imperial connection. Cecil Rhodes in 1884 went so far as to warn the Cape Government against the imperial factor. To many colonial ears the word Empire was an opprobrium, and the mention of Downing-street a reproach. The infection of separation was in the air. It is now no secret that much of the enthusiasm in certain circles for Australasian federation sprang from a desire to be ready, should occasion arise, to "cut the painter." These considerations lay at the root of the temporary failure of the Imperial Institute. All this, as if by magic, has been changed. The kingly conception of a local habitation in the heart of the Empire, for colonial gatherings and the display of colonial products, would, if now newly made, fire the enthusiasm and command the support of our Colonial Empire on the ground both of sentiment and business.

A federation presents no exception to the general rule with regard to constitutions, that those which are the result of gradual growth are more likely to be suitable than those which are ready made; just as no garment however skilfully cut can fit so well as the natural integument. Moreover, the British are essentially empirical in their methods, and have no bent for formulating systems. It does not, however, follow that a new federation can not avail itself of what may be called antecedent development. In embryology it is known that each individual passes through the various forms which the plastic hand of natural selection has, through æons of effort, impressed upon its ancestors. The organic acquisitions of countless epochs are assumed with amazing rapidity by each succeeding heir of all the ages. Even the present lords of creation had for a brief period gill slits in their necks like a shark, and a tail longer than their legs. So also federal constitutions adopt from their predecessors the proved forms that are suited to their requirements, assimilating the essential and rejecting the accidental. The wholesale paste and scissors method of construction is, however, as inorganic and mechanical as the mimicry of the Chinese tailor who in making a suit of clothes after a European pattern imitated also the patch in the trousers.

Natural selection effects improvements by the atrophy of useless organs, by the addition of new organs, and by the conversion of disused parts to new purposes. An interesting example of the last named method took place when the mammalia passed permanently out of the amphibian stage; aquatic aeration of the blood being supplanted by respiration. Gills were then no longer necessary; but instead of undergoing complete atrophy, some portions of the gill were transformed into blood vessels to meet the increasing vascular demands of the lungs and growing brain. An analogous adaptation of an ancient institution to meet a new requirement of federation occurred when, by a brilliant inspiration, the fathers of the United States constitution, in order to provide for the representation of the States in their individual capacity, devised the Senate from its original—the House of Lords. The United States also evolved the Supreme Court as a new organ to act as arbiter between the co-ordinate federal and state legislatures. The Supreme Court has not only admirably fulfilled this purpose, but as interpreter of a designedly rigid instrument of government has from time to time, by its

wide powers of interpretation, shaped the constitution to meet the necessities of succeeding generations. The Australian Commonwealth has endeavoured to secure the utmost flexibility compatible with a written constitution and in providing means for amendment has restored the referendum. The United States made a careful selection of those features which had proved serviceable in the local legislatures, and in other respects followed the British constitution as it then existed; but they excluded ministers from congress in order to secure independence from the influence of the executive. Under the altered circumstances of to-day, Australia, with quite another motive, insisted on ministers having seats in Parliament in order that the legislature might control the executive.

The fact that in Australia, for the first time in history, self-governing States spontaneously became consolidated without pressure from outside, may be taken as the index of a strongly synthetic age. A remarkably interesting variation made by the Australian Commonwealth was the granting of the Federal franchise to women on the same terms as men. This was no sudden or sporadic event, but, in the direct line of development, followed similar action on the part of New Zealand and several of the Australian States in succession. It appears, indeed, to be one of the most significant signs of the times, and may also be regarded as the mark of an age of integration. Physiologists recognise that throughout creation the male sex is more prone to disruptive changes, or, as it is termed katabolic, while the female sex is more disposed to constructive or anabolic processes. This fact appears to be the key to the constantly increasing importance of the part played by woman in every department of activity during the fifty years that have elapsed since Miss Nightingale inaugurated the era of women's influence by demonstrating that they could with advantage be entrusted with the care of the sick or wounded during a campaign. If this be the correct view, how vain must eventually prove the efforts of those who endeavour to withstand such a cosmic movement as that of which woman's franchise is the outward token. As well might one stand upon the shore and forbid the tide as strive with the weak hands of conservative prejudice to stem the advance of a reform upon which the age has set its seal.

Increased municipal powers are among the natural fruits of a federation. The idea of a metropolis which has to appeal to an Imperial Parliament for permission to provide means of locomotion in its streets or water highways is an instance of unwieldiness which could not continue under a federal form of government. Federation is a structure which gives the utmost scope to local freedom, and shields autonomy whether municipal or national, in it alone can be realised the reconciliation of Empire and Liberty.

The laws of selection apply to a federation as well as to every other organism. Between the simple *Staatenbund*, with almost independent segments like the Annulosa, and the highly complex *Bundesstaat*, whose segments are permeated by central organs, there is a wide range, and with fairly facile amending power there is no difficulty in a federal form of goverment adapting itself to varying requirements. It can ascend to higher complexity, especially by means of the Australian provision for extending the federal function by reference to it of additional powers from the States, or it can descend the scale if the mass is beyond the scope of the integrating power, and there is this advantage as compared with a unified government, that severance can take place with less injury.

In the last resort natural selection falls back, in the case of both societies and individuals, on dissolution as the sovereign remedy for unfitness. Death is in the evolutionary sense the gate of life—without this resource the pathway towards higher development would be barred against aspiring organisms. Formerly death was supposed to be the common lot of all things living, but it really came into the world as the necessary accompaniment of complex life. It is the special privilege of the metazoa. The protozoon is, under certain conditions, immortal—until it is eaten—a fate which owing to its lack of sufficient organisation is never far distant from it.

In an age of progressive competition to cry halt is to sound the bugle for dissolution. Mere acquisition of territory without corresponding organisation only increases vulnerability. The *laissez faire régime* seems to have been based on the inference that we had definitely entered upon a cosmopolitan era and that international lines of demarcation would become less hard and fast. Subsequent events have proved that this assumption was unwarranted. It is true that some old lines on the map have been obliterated. The units of Government have been enlarged. Nations have expanded into empires, but

it is only what may now be regarded as internal divisions that have been removed. The ring fences are stronger and higher than ever. Once again something has happened to the millennium express. Iron and steel are still in demand for other purposes than the manufacture of ploughshares and pruning hooks. The movement which Herbert Spencer imagined was only a reaction towards the military type of society bids fair to become the settled line of march. In the face of an industrial competition of ever-increasing severity, which may now be said to be inter-imperial rather than international, regimentation even of the industrial type of society appears to be imperative.

Herbert Spencer wrote that :—" In essence Toryism stands for the control of the State versus the freedom of the individual, and in essence Liberalism stands for the freedom of the individual versus the control of the State." If this be so, true blue may again become the only wear, for State action appears to be the order of the day; only in future it will be exercised for national and imperial, not for mere class benefits. The report of the Royal Commission on the Port of London furnishes interesting matter on this subject in the following paragraph :—

" The power of undertaking large present expenditure, and of working for a long time at a loss with a view to compensation in a distant future, is, no doubt, in a keen world competition, an advantage possessed by undertakings which have the force of an Empire, State, or great city behind them. If in some countries national and municipal resources are thus employed, it becomes most difficult for private enterprise elsewhere to hold its own against the intelligent, far-sighted, and formidable rivalry thus created."

Only those empires can survive which throw into the struggle the whole force of their organised power.

The question with which we are confronted is whether the synthetic power of the British people is equal to the new demand, whether we are to be not merely builders but users of Empire, whether Great Britain is doomed to succumb in the struggle to some world power capable of a higher organisation? In our hearts we know that this cannot be. Looking back we see with what unerring instinct the race has marched towards the realisation of its destiny. At one time inclining towards diversity, and again towards union. We can now discern how at each stage just the necessary step was taken at the right time.

We cannot now picture the vision familiar to our parents of the "mother of nations, so long habituated to family life, again resuming the self-contained and solitary housekeeping of a spinster," even if in a hostile age this were possible. Reason joins with instinct in assuring us that the evolutionary force that shaped the Crown of England out of the scattered elements of the Heptarchy, that joined with it the sister nations of Scotland and Ireland, that planted the Union flag on every continent, is still mighty to save, and that the power which has hitherto led us will, in spite of feeble measures and divided counsels, still continue to guide our steps towards the great fulfilment, for

" No ordinance of man shall override
The settled laws of nature and of God,
Not written these in pages of a book,
Nor were they found to-day, nor yesterday;
We know not whence they are, but this we know—
That they from all eternity have been,
And shall to all eternity endure."

DISCUSSION.

Mr. MORETON FREWEN thought Sir John Cockburn had covered the subject of the paper in the most admirable manner. The text that had been borne in upon him while listening to the paper was the remark one so often heard in America, that there was a providence which looked after children and drunken men and the United States of America. Providence had looked after the British Empire in a most unexampled fashion. The Empire, which, as the author had pointed out, it was the desire of our statesmen fifty years ago to give away, had yet hung together under the conditions which the author had enumerated. They had developed their own institutions and their own representative Governments; and in the fulness of time, which was the twentieth century, those various large bodies had come to a condition of things where federation was now ripe. When he was in Adelaide in 1895 he had the opportunity of discussing the question of the federation of the Australian Colonies with the author. He (Mr. Frewen) had come from New South Wales, and had found in that free trade colony the very strongest objections to the federation of the various Australian Colonies. He went on to Adelaide from Sydney so imbued with the sentiment of the New South Wales colonists that he laughed at Sir John when he said that, in his judgment, the federal period had come. He replied that it might come in twenty-five, thirty-five, or fifty years, but that he was quite convinced there could be no federation within their lifetime. The reasons always given in Australia at that time why federation was not near was that the extraordinary antipathy of the colonists of Victoria and New South Wales, the one representing High Protection and the other Free Trade, could never be modified in less than a generation; it was said that it

was perfectly impossible for those two colonies with their separate fiscal systems ever to engage in free inter-state trade; and yet in a few years that had come to pass, which he thought was an augury of considerable hope to the British Empire in the future. The paper was so brilliantly comprehensive that it covered all sorts and conditions of political philosophy. One thing which often occurred to him, particularly when he was talking with their colonial friends, was the extraordinary results on their political philosophy that were likely to come with the federation of the British Empire. In England politics had been the politics of temperament; a man was a Conservative, or, on the other hand, a Liberal as his temperament dictated; as he was inclined to be an optimist, and as he believed in experimentalism so his politics were largely dictated. If they were to come together and be a great federal empire the politics of temperament must disappear, and, as was the case in the United States to-day, the politics of environment must be the politics which would assume the position. What he meant was that in the United States a man said he was a Democrat or on the other hand a Republican, accordingly as he viewed the relation between his State and the federal centre. A man in the States said, "Do I rely upon my State Legislature for the making of my laws, or do I wish to give even more power to the federal centre." He thought that was a more wholesome political condition than the politics of temperament such as we had, and for that reason he thought they all welcomed heartily the federation of the Empire, because it would give us a new system and a new condition of political thinking. Further than that, he thought questions arose which, to some, extent, were not touched upon in the paper. He could not help seeing that with the federation of the Empire, which they hoped to be near, there would be a solution of certain grave constitutional problems which at present were distressful. In the first place, if a federal union of the Empire were arrived at Ireland would emerge from that federated Empire as a State of a federal union, entitled to a State Legislature, just as the State of Ohio or the State of Texas were entitled to their State Legislature. Again, if a federation of the Empire were arrived at, there must be certain changes in the Second Chamber in England, which, he thought, would be popular, even to the Peers themselves. All those things seemed to be at hand now. The twentieth century, subject to the conditions which the author had pointed out, had in its keeping those blessed changes which would federate the Empire for all time.

Sir GUILFORD MOLESWORTH, K.C.I.E., said that the author had dealt very fully with the subject of the biology, but had said nothing at all about the nosology of federation which affected it very closely, viz., the parasites or the diseases of the organisms. English federation had suffered a good deal from parasites, and, perhaps, from want of sufficient nourishment. Very few people who had not resided in the Colonies could realise the immense amount of trade which had been lost to England by the fact that it was taken away to a very great extent by the foreigner, because the foreigner possessed greater advantages than the British subject, who, being in competition with the foreigner, suffered in that respect. For instance, a British subject was exposed to a double income tax if he had, as most British merchants had, a domicile in England. The foreign merchant in the Colonies, if he had not a domicile in England, but merely one in his own country, escaped that double income tax, and really paid nothing towards the upkeep of the Government of the country, and the army and navy which protected his colonial interests. The result was that British subjects were handicapped, and had no chance in competitive markets. England had gained Colonies at great expenditure of blood and treasure, but it did not make the best of them; it did not nourish them, but gave them insufficient food. England looked at them from the selfish, insular, and short-sighted point of view of what direct advantage was to be gained from them, and not from the wide point of view that should be held; it made no sacrifices, and gave the Colonies no advantages. It seemed to him very absurd, that, having the Colonies, England should not give them, and that they should not give us, mutual advantages and preference to encourage interchange of trade.

Mr. H. ALLERDALE GRAINGER (Agent-General for South Australia) thought it right to mention that if it had not been for the author's unceasing labours and those of a few more men like him, there would have been no federation in Australia today. After the first General Election, which was held on the 16th December last, when the Colonies had had three years' experience of federation, it did not look as if federation was very popular in Australia. Only about one man in three went to the poll; and although in Queensland they had been saying, "Wait till the next election, and we will turn this Labour Party out of the Senate," the result of the election was that in Queensland the Labour Party was stronger than ever. He thought Senator Maddison, who was present, would support him in the view that, so far as federation in Australia is concerned, it did not seem to be quite so popular as they hoped it would be by this time, although he believed with the author that it would come right in the end. He wished to call attention to the fact that the greatest critics of the Commonwealth Act were the Labour Party; they stumped the country from one end to the other against the Federal Bill; and whether the electorate sided with the Labour Party on that account or from other reasons, there was no doubt the Labour Party had scored a great victory and that a large number of one time ardent federalists had not gone to the poll. But he believed all those things in Australia, as in any other English community, would bring about their own cure. Mr. Moreton Frewen had referred

to probable changes in the House of Lords. When the people of this country woke up sufficiently to demand a change in the constitution of the House of Lords, he had no doubt it would be brought about in due time. If Mr. Moreton Frewen or somebody else would compile a record of the votes of the bishops from time immemorial, showing that they always voted against the interests of the public, an agitation would spring up, and very likely the bishops would go. But it was not the constitution itself, whether in England or Australia, but the commonsense of the people that would pull them through. He was very glad to say that Englishmen were able to survive in spite of their constitution, and if they had not that stupid commonsense which they were chaffed about by the foreigners, they could not have colonised in the way they had done. Germany, France and Holland had tried colonising on different lines, but he thought he might fairly state there was no nation in the world which could colonise like the British nation; and they did it by that stupid commonsense of the Britisher, who never knew when he was beaten, and went on, because he was stupid, until he succeeded. It was for that reason he had hopes that, however faulty the Commonwealth Act might be—and he thought there were some faults in it—it would come right in the end.

The CHAIRMAN (Sir Westby B. Perceval), in moving a hearty vote of thanks to Sir John Cockburn, said he did not know when he had listened to a paper with such pleasure and profit; when a student of politics was grafted on to a man of science, the product was highly satisfactory. The tribute of appreciation which Mr. Grainger testified with regard to the work Sir John did in Australia was only too well merited. He had taken a most active part in the movement from its inception, and had no little hand in bringing the work to a satisfactory completion. The federation of Australia was one of the most important works of our time. There was a federation in Canada and in Australia, and the federation of South Africa was sure to follow in a few years; and then they would be able to pave the way to what they all desired sc much, a more intimate federation of the Empire as a whole. As long as the rule which Sir John had suggested was observed, namely, the necessity of not arresting the desire for variation, provided disintegration did not follow, then he thought they might look forward to the future with the greatest hope. They fully admitted the necessity of giving to each part full control of its own affairs, and demanded from each part that it should recognise the duties and responsibilities to the whole organism. That he thought the British public, whether here or in the Colonies, thoroughly recognised; and as long as that was not forgotten there was every reason to hope that a most successful issue would be arrived at in their efforts to bring about a closer union of the people of the Empire in whatever part they might be.

The vote of thanks being carried,

Sir JOHN COCKBURN, in reply to Mr. Moreton Frewen, said that the feeling of individuality which, at one time inclined a large number in one of the colonies (and might do the same in the future) towards separation, was a feature which was allowed full development in federation. That was one of the advantages of federation; the two movements were quite consistent. He might have mentioned in his paper that the advocacy of Australian federation commenced more than fifty years ago, and it was while that advocacy was still going on, that the separation of Victoria, on the one side, and Queensland on the other, from the mother colony of New South Wales took place. In federation, the existence of a States Rights Party which desired to protect the individuality of the State as far as possible and protested against further augmentations of federal power, was just as essential as a centralising influence. The two were necessarily balanced. One of the things which had to be understood and realised was that those apparent contradictions were in reality only the two sides of a shield, and if they were properly and organically combined, they became harmonious; but they must not be content with a mere mechanical adjustment of them. In reply to Sir Guilford Molesworth's remarks, he was not dealing in the paper with pathology, but with physiology. He believed there was sufficient integrating force for health, if the force was allowed full play; that was what the strength of any constitution meant. There were all sorts of maladies which he did not think would develop to serious diseases, but they were in an unsatisfactory state. In regard to the food supply, taking it from a biological view, when they had to depend upon other countries for their vast supplies, they were in the condition of a patient who depended upon transfusion of blood for the maintenance of his existence. That was not a normal and healthy condition of things; but the integrating force which had now made its appearance would cure that evil, and parasitic and other diseases would fall off as the green fly did from a healthy and growing cabbage. In reply to Mr. Grainger, there were no doubt big problems to face in Australia. He thought Mr. Grainger regretted as little as he himself that there was a fairly strong Labour Party in Australia. The labour representatives were very different men from what some people in England imagined. Anyone who had been to Australia would bear him out that the labour representatives there included many educated, cultured gentlemen, better versed in the history of the British Empire than ever he could pretend to be, and far and away better read than the average member of Parliament, and who were among some of the most eloquent speakers, who were industrious in their work, and who did not present any of those qualities which English people were usually accustomed to associate with the labour agitator. They were level-headed men

of strong commonsense, and for his own part, he did not regret that the Labour Party had come to stay in the Federal Parliament. It was not well for any party to predominate, but, as Mr. Grainger indicated, events had happened during the last year, which he believed were responsible for the wave of increased labour representation. The only thing to be feared was that a lack of the power of variation might supervene, which would mean the end of the British Empire. The British Empire had developed so far, and would continue to develop, not because everyone agreed, but because they agreed to differ; and the hope of this country, and of the united nations of the British Empire, lay in the fact that in the Colonies there was scope for that variation which alone could adapt the machinery of the Empire to the requirements of the future. The institutions of the future could not be cast in the moulds of the past; that was the one fatal thing to attempt to do; and the only hope of escaping from that difficulty lay in the initiative of the Colonies. He, therefore, pleaded for a little more mutual understanding and better faith. When people here heard that Australia or Canada had done this that or the other they should not go about shrieking red ruin; those communities were permeated by strong commonsense; Australians were not fools, they knew quite well what they were doing; and in finding ways of solving their own problems they were introducing just that variation which was the hope of the future. As long as the power of adaptation existed, as long as the British people in the Colonies were imbued with strong commonsense, so long that commonsense would weed out from the plot of variation what was unsuitable, and preserve and nourish the growths that were suitable for development.

TENTH ORDINARY MEETING.

Wednesday, February 17, 1904; the EARL OF DENBIGH in the chair.

The following candidates were proposed for election as members of the Society:—

Bousfield, William, M.A., J.P., 20, Hyde-park-gate, S.W.
Doulton, Miss Katharine D., 26, Cadogan-place, S.W.
Johnson, Philip Henry, A.M.I.Mech.E., The South African Road Transport Co., Ltd., P.O. Box 45, Kroonstad, Orange River Colony, South Africa.
Read, Charles M., A.M.I.Mech.E., The Cape Peninsular Lighting Co., Central Power Station, Claremont, Cape Colony, South Africa.
Reece, Eardley B., The Treasury, Accra, Gold Coast Colony, West Africa.
Stilwell, J. B. L., 42 Pall Mall, S.W.

The following candidates were balloted for and duly elected members of the Society:—

Belfond, J., Officier d'Académie, Broglence-villa, Melrose-terrace, West Kensington-park, W.
Britton, H. Aaron, Plaisance Village, East Coast, Demerara, British Guiana.
Campbell, Henry Alexander, J.P., Lynford-hall, Mundford, Norfolk.
Chinnery, Walter Moresby, J.P., D.L., Hatchford-park, Cobham, Surrey.
Drummond, C. S, 23, St. Mary Axe, E.C.
Fitzhardinge, Arthur Frederic, P.O. Box 177, Cape Government Railways, Capetown, South Africa.
Fry, Miss Catherine Alethé, 27 Morpeth-mansions, Victoria-street, S.W.
Ghosh, A. Surath Kumar, F.R.A.S., 28 Elgin-avenue, W.
Goetz, Isidore. A.I.M.M., 2 Kelfield-gardens, North Kensington, W.
Heaton, James, Ravenhead, St. Helens.
Mackenzie, Thomas, F.C.S., 4, Church-street, Inverness, N.B.
Munro, Alfred James, 16, Holford-square, W.C.
Rice, George Brackett, M.D., Clarendon-street, Boston, Mass., U.S.A.
Stott, Clement H., F.S.I., F.G.S. (Messrs. Stott and Kirkby), Harwin's Arcade, Timber-street, Pietermaritzburg, Natal, South Africa.
Tatham, Frederick S., K.C., M.L.A., J.P., 7, Timber-street, Pietermaritzburg, Natal, South Africa.
Taylor, Rev. Samuel I., B.A., 157, Fourah Bay-road, Free Town, Sierra Leone, West Africa.
White, Thomas John Ayrton, Simmer and Jach Proprietary Mines, Limited, P.O. Box 192, Germiston, Transvaal, South Africa.

The paper read was—

GARDEN CITIES IN THEIR RELATION TO INDUSTRIES & AGRICULTURE.

By A. R. SENNETT.

"Return to the land!" that is the admonition involuntarily rising to our lips when contemplating the toilers of our great cities and noting the baleful conditions under which they exist; it were inutile to give it expression, for we know it to be impracticable under existing conditions of the greatest of our industries—Agriculture. "The return to the land," nevertheless, is the direction in which we must look, not only for the relief of urban and rural distress, but also for the recuperation and maintenance of our degenerated physique.

To stem the gravitating tide of men and material to great and consequently overcrowded centres, and to provide means for the return of man to the land and the engagement in manufactures in the open country, are the

principal objects of Garden Cities, a movement involving the solution of a problem now presenting itself to the thinking mind as one of grave and national importance.

That strenuous, conscientious, and well-directed effort *should* be made, and this without delay, to neutralise the evil effects of overgrown populations, is clear; of this no doubt can exist in the unbiassed minds of all thoughtful persons. Earl Grey, in a recent speech, said: "It is admitted on all hands that most of the larger cities of England, owing to their ill-regulated and anarchic growth, have become the very cancers of our body politic, and that they are sapping the strength and poisoning the character of the nation. No one who realizes that physique and character are the products of environment, as well as heredity, can fail to regard the suburban excrescences of our smoke-enveloped and air-exhausted towns with feelings short of positive consternation."

Obviously, there must have been reasons for the gravitation of the populace to large centres. At the outset, therefore, we have to ask ourselves the two questions, "Do the reasons still obtain? and, Are they remediable"? It would take too long to analyse these causes, but the two of paramount prepollence are (*a*) the inability of the land—as at present worked—to support more than a very sparse population, and (*b*) the inability of agriculture—as now carried on by us—to offer a rate of wage commensurate with that obtainable from urban industries. Unhappily, we see the causes still exist, both for urban influx, a deplorable rate of emigration, and for agricultural depression.

It shall be my earnest endeavour this evening to show that the reasons *are* remediable and the causes removable. In my efforts I shall avoid entirely soaring into the realms of speculation and communing with the stars of the unattainable; for I shall confine myself entirely to the land, and to consideration of the mode and instrument whereby other nations have avoided, not only our depression, but have been enabled to show aggrandizement and advance more than counter-balancing our shrinkage and our retrogression. It may be desirable to say at once that the mode they have adopted has been more apposite legislation, whilst for their instrument they have taken the application of science to agriculture as well as to their industries.

Happily, both these courses are open to us, and I suggest that so serious are the effects now existent with us, arising out of our neglect of both, that it behoves every patriotic Briton to temporarily efface from his mind all party considerations and to address himself to remedial measures and to amelioration.

Axiomatically, any measure having the effect of fostering and increasing that most ancient and most important industry Agriculture must, *per se*, be a measure of national importance. This is an axiom applicable to all countries. In regard to the British Isles, however—in dealing with problems having for their object either the amelioration or extension of rural industry—more thought than is necessary elsewhere should be bestowed upon the *particular branch* of agriculture to which it is wisest to devote attention and effort. This necessity arises from various conditions, favourable or unfavourable, but principally the latter, existing as characteristics of the British Isles. Of these may be mentioned such points as (*a*) our inability to provide for the whole of our wants; (*b*) the cost to ourselves in otherwise fulfilling them; (*c*) our restricted acreage; (*d*) our excessive rainfall and the absence of sunshine; (*e*) the uncertainty of our climate. In regard to the first, seeing that we are only able to feed ourselves but partially, it is clearly obvious we should bestow our attention upon that branch at present costing us most dearly. To ascertain what this branch may be, one must have recourse to statistics bearing upon the subject. I have here only entered upon those I think necessary to elucidate the points I desire to touch upon.

At the very outset our thoughts inevitably turn to the "staff of life," and lead us to consider ways and means of increasing the volume of wheat grown by ourselves, with the collateral advantages of improving the condition of the agricultural labourer and providing for the employment of larger numbers of these national wealth-producing units.

If, however, we look somewhat more deeply into the problem one is forced to admit that this is not the most prudent manner of attacking it. Before, therefore, venturing upon anything in the nature of suggestions it will be advisable to make this clear to ourselves. Although my object is to trace and define the effect readjustment of production would have upon our islands, and primarily to limit the benefits to ourselves, I feel there is only one proper method of viewing the matter and that is to look upon the British Empire as part and

parcel of the British Isles, and each as a branch of one great family—concrete and interdependent. I would ask my hearers to kindly take this view during the reading of the paper, because both arguments and calculations are materially influenced by it.

It is clear that if our Empire be looked upon as one great commercial firm composed of various departments and a number of branch establishments, a scheme of interworking may be devised, culminating in an all-round profit to the firm and such as could not be worked out if the branch establishments—in this case our colonies—were considered as apart from ourselves. A moment's thought will serve to show that in regard to such an aggregated whole it might be to its advantage for one branch to desist from the production of a specific commodity and to entrust its cultivation to another. If you will be good enough to look upon our subject from this point of view, then I feel that possibly you may, with me, cease to deplore certain facts we have been in the habit of deploring; to appreciate, moreover, that we, in striving to continue with certain branches of agriculture for which our climate and conditions are not propitious, may have been striving in an ill-advised direction.

Let us for a moment analyse this view in regard to the product first touched upon—viz., wheat. *Primâ facie*, nothing could be more deplorable than the fact that the result of half a century of British farming has been to allow our acreage of land under wheat cultivation *to fall to little more than a third of what it was when our population amounted to little more than one-half of its present number*. If, however, as I suggest, we look upon our home lands and those of our colonies as one great farm, engaged in the production of food for one great Empire, then a little thought will serve to show us that that which appears to be a loss is, as a matter of fact, a financial gain. An Empire gain which, were a lesson taken out of the book of the foreigner, could, it is obvious, be vastly augmented.

To comprehend this we have only to consider the magnitude of the bills we pay for bread, vegetables, and meat respectively in regard to such of these edibles as we are ourselves incapable of rearing upon that small portion of the vast farm comprised within the British Islands. In regard to the first item (wheat), we pay out in respect to the imported proportion of this edible alone, the enormous sum of £47,250,000. Of this amount we pay to the foreigner £28,000,000 and to our colonies only £8,750,000, whilst the value of the wheat raised *within* the British Isles is but £10,500,000.

Thus we see that if we ceased to grow wheat *entirely* we should only increase our extraneous indebtedness by a matter of about 20 per cent. (in actual figures 22$\frac{2}{9}$ per cent.). We see, moreover, that instead of paying £28,000,000 to the foreigner we ought to pay £36,750,000 to our branch establishments—our colonies. But, and this is the important point we must not for a moment lose sight of, wheat-growing is *not* a profitable occupation for the British farmer, nor is it that affording the greatest amount of employment to our labourers. Therefore, continuing to deal with our subject in a purely business-like spirit, these facts at once show that the firm should delegate the production of this commodity to one of its branch houses.

Obviously, the next point to determine is, to what extent would the British farmer be benefited by substituting for wheat-growing another branch of agriculture for which our climate is better suited? We are, therefore, brought to consider the magnitude of one of the other two bills. We will take that for our vegetables. Unfortunately such *data* does not exist as to enable us to ascertain the value of our home-raised vegetables; but this, unhappily, we do know—that Dame Britannia *every year* has to write a cheque of no less than £5,465,881 for vegetables and fruit sent in to her from abroad. Now, to grow the *fifth* part of the wheat we consume we still have under cultivation 1,701,000 acres, but the return from their cultivation is of the most unsatisfactory nature; moreover, as our agriculturists inform us, *none* of the paltry return is attributable to wheat-growing *per se*. It is sufficiently obvious, therefore, that if these 1,701,000 acres of land—especially if they formed broad girdles around Garden Cities—were no longer used for wheat-growing, but for the supply of the *five and a half million pounds worth* of vegetables and fruit required by us, then this enormous sum would pass through the hands of the British farmer, instead of passing into the pockets of the foreign agriculturist.

But the point may be raised that this acreage might be in excess of that required for the supply of fruit and vegetables, the two commodities under consideration. We are thus led to consider another branch of agriculture, and to inquire into the amount of that proportion of our dairy-produce bill we are forced to

TABLE I.—IMPORTS OF VEGETABLES, 1898-1902.

Potatoes.

Year.	Quantity Imported.			Value in £.		
	Foreign Countries.	Channel Isles.	British Possessions.	Foreign Countries.	Channel Isles.	British Possessions.
	Cwt.	Cwt.	Cwt.			
1898	5,499,532	1,192,094	1,252,196	1,335,805	547,356	578,107
1899	3,797,674	1,338,115	1,361,337	965,422	601,427	612,304
1900	7,800,245	1,054,486	1,110,717	1,670,763	538,813	563,806
1901	5,976,064	1,020,654	1,100,662	1,369,831	447,680	481,756
1902	4,408,240	1,268,098	1,290,850	1,099,336	481,134	490,096
Total ..	27,475,755	5,873,447	6,115,762	6,441,157	2,616,410	2,726,069

Grand total, £11,783,636. Average, £2,356,727 per annum.

In the third Table the items under the heading Vegetables unenumerated, and other than the foregoing, represent our annual expenditure on such articles as lettuces, cabbages, spinach, peas, beans, &c., entities coming in from Holland, Belgium, and France. A similar list of green fresh vegetables from the Channel Islands accounts for the amount under the head of British Possessions. It should here be explained, lest it might be thought the amount of these imports was decreasing and we were asserting our supremacy, that before the year 1900 under this head were included tomatoes and some other articles since removed from the Table and tabulated separately. The year 1900 seems to have been phenomenal in regard to imports of green vegetables, but careful research points to the fact that year by year the amount of our imports from Belgium, Holland, and France greatly increases.

Onions.

Year.	Quantity Imported.			Value in £.		
	Foreign Countries.	Channel Isles.	British Possessions.	Foreign Countries.	Channel Isles.	British Possessions.
	Bushels.	Bushels.	Bushels.			
1898	5,924,199	..	78,316	783,699	..	9,210
1899	7,004,874	..	13,425	843,822	..	1,930
1900	7,046,828	..	40,277	846,963	..	5,533
1901	7,270,068	..	25,350	866,765	..	2,632
1902	7,597,219	..	8,270	998,292	..	1,650
Total ..	35,043,188	..	165,638	4,339,541	..	20,955

Grand total, £4,360,496. Average, £872,099 per annum.

Tomatoes.

Year.	Quantity Imported.			Value in £.		
	Foreign Countries.	Channel Isles.	British Possessions.	Foreign Countries.	Channel Isles.	British Possessions.
	Cwt.	Cwt.	Cwt.			
1898	..	..	..	..	..	..
1899	..	..	..	..	..	..
1900	676,335	156,070	625	504,443	287,147	749
1901	624,355	169,584	56	467,231	266,198	42
1902	648,039	135,855	..	485,747	214,379	..
Total ..	1,948,729	461,509	681	1,457,421	767,724	791

Grand total, £2,225,936. Average, £741,978 per annum.

Value of Imports of Vegetables other than the foregoing.

Year.	Value in £. Foreign Countries.	Value in £. British Possessions.	Total.
1898	1,254,737	426,049	1,680,786
1899	1,274,388	470,170	1,744,558
1900	718,251	48,143	766,394
1901	345,486	44,343	389,829
1902	399,768	68,643	468,411
Total....	3,992,630	1,057,348	5,049,978

Average per annum, £1,009,995.

TABLE II.—IMPORTS OF FRUIT, 1898-1902.

Apples.

Year.	Quantity imported. Foreign Countries.	Quantity imported. Channel Isles.	Quantity imported. British Possessions.	Value in £. Foreign Countries.	Value in £. Channel Isles.	Value in £. British Possessions.
	Bushels.	Bushels.	Bushels.			
1898	1,848,146	26,204	1,610,570	574,539	8,565	533,517
1899	2,109,152	25,573	1,752,020	611,640	7,345	574,503
	cwt.	cwt.	cwt.			
1900	1,227,363	7,962	901,178	677,604	4,938	547,053
1901	1,206,184	16,749	624,026	722,946	7,313	459,836
1902	1,743,444	6,228	1,100,073	1,160,273	4,319	763,201
Total ..	..	..	..	3,747,002	32,480	2,878,110

Grand total, £6,657,592. Average, £1,351,518 per annum.

Pears.

Year.	Quantity imported. Foreign Countries.	Quantity imported. Channel Isles.	Quantity imported. British Possessions.	Value in £. Foreign Countries.	Value in £. Channel Isles.	Value in £. British Possessions.
	Bushels.	Bushels.	Bushels.			
1898	451,359	10,626	40,310	207,985	5,579	13,795
1899	554,064	11,114	17,768	254,955	6,312	11,396
	cwt.	cwt.	cwt.			
1900	466,466	8,421	10,435	356,880	7,909	9,980
1901	334,273	11,267	14,613	282,881	9,242	13,530
1902	482,271	5,576	9,635	427,741	6,102	11,795
Total ..	..	..	..	1,530,442	35,144	60,496

Grand total, £1,626,082. Average, £325,216 per annum.

Plums.

Year.	Quantity imported. Foreign Countries.	Quantity imported. Channel Isles.	Quantity imported. British Possessions.	Value in £. Foreign Countries.	Value in £. Channel Isles.	Value in £. British Possessions.
	Bushels.		Bushels.			
1898	917,851	..	4,397	431,288	..	3,378
1899	553,545	..	4,728	289,770	..	4,282
	cwt.		cwt.			
1900	422,493	..	526	391,052	..	1,644
1901	260,742	..	2,958	238,309	..	5,396
1902	539,358	..	1,778	511,267	..	3,792
Total ..	..	..	..	1,861,686	..	18,492

Grand total, £1,880,178. Average, £376,035 per annum.

Strawberries.

Year.	Quantity imported.			Value in £.		
	Foreign Countries.	Channel Isles.	British Possessions.	Foreign Countries.	Channel Isles.	British Possessions.
1898	..	..	..	..	..	..
1899	..	..	..	..	..	..
1900	cwt. 52,219	cwt. 6	..	85,921	28	..
1901	38,573	31	..	51,132	158	..
1902	40,193	18	..	58,005	75	..
Total ..	130,985	55	..	195,058	261	..

Grand total, £195,319. Average, £65,106 per annum.

Fruits Imported from Foreign Countries only.

Year.	Quantity Imported.			Value in £.		
	Cherries.	Currants.	Gooseberries.	Cherries.	Currants.	Gooseberries.
1898	Bushels. 401,810	Not recorded.	Not recorded.	230,828	Not recorded.	Not recorded.
1899	281,230	,,	,,	153,642	,,	,,
1900	Cwt. 242,508	Cwt. 64,462	Cwt. 26,045	308,340	87,170	14,626
1901	212,632	70,402	21,735	213,548	75,308	11,420
1902	166,359	76,080	27,564	216,421	92,112	16,919
Total ..	..	..	..	1,122,779	254,590	42,965

Grand total, £1,420,334. Average for the last three years only, £345,288 per annum.

TABLE III.—IMPORT OF FLOWERS.

Year.	Value in £.		
	Foreign Countries.	Channel Isles.	Total.
1900..................	131,842	68,743	200,585
1901..................	146,416	78,495	224,911
1902..................	167,139	100,142	267,281
Total....	445,397	247,380	692,777

Average per annum, £230,925.

pay annually to foreign countries. The magnitude of this bill, again, is vastly surprising, especially when one considers how perishable are the commodities involved and the difficulty of getting them delivered fresh from abroad, for it amounts to no less a sum than £27,139,413.* Thus we see that the total sum paid to foreigners for vegetables, fruit, and dairy produce is no less than £32,605,294. We see, moreover, and this is a point to which I desire to direct your special attention, that we pay the foreigners for edibles, namely, market garden and dairy produce—comestables we could supply ourselves with at prices highly remunerative to our farmers—a

* This amount is made up as follows:—

Butter	£17,992,404
Cheese	1,978,981
Eggs	6,099,418
Milk	6,224
Cream	26,386
Poultry and game....................	1,035,000
	£27,138,413

This amount is exclusive of the *eight and a quarter* million pounds worth of Colonial dairy produce. I have also purposely taken no account of the *two and a half* millions of vegetables and fruit received by us from the Channel Islands and other colonies, whilst all fruits and vegetables—such as cannot be appropriately grown by us in the open air—have also not been taken into consideration.

sum equivalent to more than *three times the total value of our home grown corn*, a commodity we grow at a loss.

It is clear that the execution of this gigantic order by our own farmers would result in the putting under market-garden and dairy-farm cultivation of a vast number of acres of land, the profitable use of further capital in agriculture, and the employment of a small army of cultivative artisans. I speak of them advisedly as "artisans," rather than as "labourers," because the day must soon arrive—ought, indeed, to have arrived—when the cultivator of the soil shall be a skilled artisan—a *status* to which he has already attained elsewhere. It would, perhaps, be as well to refrain from any calculation of the actual acreage that would be entailed, because, unhappily, the acreage necessary for the British agriculturalist is greater than that required by his foreign competitors, who have exercised, and now reap the reward of their prescience in regard to the value of the application of science to the land. We have no need of calculations to prove that many thousands of acres of land are to-day tilled and profitably utilised abroad in fulfilment of *our* requirements, which acreage would be transferred to the face of our own islands were we to supply for ourselves a greater proportion of our vegetable and dairy produce needs.

So much, therefore, for points (*a*) and (*b*)—our inability to provide for the whole of our wants and the cost to ourselves of partial fulfilment. As to (*c*), the fact that our acreage is restricted serves only to emphasize the necessity for the more profitable employment of such as we are possessed of. As to (*d*), excess of rainfall and absence of sunshine, these, albeit they are matters of vital importance in regard to cereal crops—of which the past year has proved a cruel reminder—they are, to a far greater degree, negligible in connection with vegetable growing and dairy-farming; whilst in respect to the last — uncertainty of our climate—this should but direct our attention more earnestly to *intensive* culture, a form of agriculture to be found, unfortunately, in a far more advanced state elsewhere than in Great Britain, and upon which I venture very briefly to touch.

Such a readjustment of agricultural production, looked at from the purely business standpoint, would be redolent of financial advantages; but from the point of view of national security it presents a disadvantage. If, however, we reflect upon this point, we shall find it to be of far smaller moment than at first sight it would appear. We have to ask ourselves "how long in case of war could we supply ourselves with corn under normal conditions?" The reply is sufficiently unsatisfactory, for our annual yield of wheat would but support us for the short space of three months. A good deal has been said lately about the necessity for providing national granaries; indeed, at the present time a Royal Commission is sitting to consider such matters. Now, it is obvious, in this respect, that the disadvantage would not go beyond the necessity of increasing the size of such granaries to the extent of storing an additional amount equal to that of one year's crop or *three months* supply.

But the fact appears to have been largely overlooked that the provision of such granaries would *not* obviate the necessity of keeping up a navy of appropriate magnitude for the safe convoy of corn from one part of the Empire farm to another, more especially our own little islands. Our navy we *must* keep up! its *raison d'être* lying quite outside the subject we are now considering. On *a priori* grounds, therefore, rather than entering upon enormous expenditure in respect of national granaries, it would be far more prudent to spend money in additions to the navy, instead of having to face a huge annual outlay in this regard—represented by the interest of money so expended, and that upon the corn stored—to which disadvantages would probably be added dislocation of trade consequent upon periodic discharge upon the market. Such charges should in equity be debited to the cost of wheat, thus increasing the price of bread. Clearly we should obtain better value for our money in expending it upon the upkeep of a navy of increased strength, the expense of which could justly be otherwise debited. Better to do business with *our own "branch houses*," whose fighting material would be at our disposal in time of need, than with competitors whose armaments would be directed against us.

Continuing to view our subject as affecting the interests of a great business house, a glance at the figures brings out another most unsatisfactory point, for we observe that whilst we send orders to our own branches amounting in the aggregate to only £8,750,000, we purchase wheat from foreigners to the enormous figure of £28,000,000—nearly three times what we ourselves grow. What, we surely should ask, would the directors of a business concern do upon

disclosure to them of such trading ratios? There can be but one reply. They would proceed to recast their business arrangements in suchwise that more of their needs should be supplied by their own departments. Such a readjustment, current events would seem to indicate, will have to be entered upon in regard to our national trading in connection with the subject now under consideration. Let us now consider the position from the point of view of those who appear to consider the home-farm — the British Isles — should be commercially isolated from the branches—our Colonies.

If the view be taken—and, having regard to the foregoing remarks concerning national security it might be considered a prudent one—that the amount of our home-grown wheat should be *increased*, then it is obvious the readjustment must be such that wheat-growing shall become a profit-earning occupation for our home farmers. Here we become confronted with a problem very difficult of solution. The readiest means of converting a losing operation into a profit-earning occupation is to increase the selling price of the entity produced, but in the case before us, *ex necessitate rei*, the rise in price of one product must *not* entail the rise in price of another manufactured from it—practically a *non possimus* in ordinary industrial processes, unless the conversion be of such nature that some bye-product results which more than balances the loss. Put into the plainest language the problem to be solved involves the raising of the price of wheat, without raising the price of bread made from it.

Nevertheless, it is probable solutions will be forthcoming when they are called for, and it might be interesting to indicate one such: Suppose that an import tax, with preferential treatment to our Colonies, should be put upon wheat, in order to raise its price to that at which it would become a profit-earning entity for the British farmer—instead of a losing one, as at present—and that, from the revenue thus obtained, bread-making—*by means of a bounty upon flour*—should be subsidised just to the extent necessary to prevent any rise in price of the "staff of life," the deficit being made good out of taxation of other imported *manufactured* goods, in regard to which we at present have to submit to most unfair treatment, as, for example, American and German machinery, which is frequently "dumped down" into our country at less than its cost price, whilst upon *our* machinery going into America or Germany an enormously high taxation has to be met. If we are to act both prudently and patriotically, it is clear we must not only make corn-growing a profitable occupation for our home farmers, but we must also extend to our Colonies preferential treatment such that they will be enabled to supply our shortage instead of the foreigner. At first view it might be thought the best way to do this would be to admit our Colonial cereals free, but reflection will show that this course would only efficiently fulfil *one* of the two *desiderata*; though it must be remembered the mere temporary imposition of a small registration fee of 2s. per quarter upon corn had a markedly beneficial effect upon our milling industries, if not actually upon agriculture. This lesson, therefore, teaches us we should go further.

Let us therefore assume, for example, that an import duty of 9s. per quarter be put upon foreign wheat, and one of 7s. upon Colonial wheat. The revenue obtained would be £11,187,500. The expenditure in bread subsidies £15,187,500. The deficit, made good from taxation of manufactured goods, such as those to which I have referred, £4,000,000.

This would work out as follows:—

REVENUE.

Foreign wheat, 80,000,000 cwt. at 9s.	£9,000,000
Colonial wheat, 25,000,000 cwt. at 7s.	2,187,500
Subsidy to bread (paid from taxation upon manufactured imports)	4,000,000
	£15,187,500

EXPENDITURE.

Increased cost upon total consumption (135,000,000 cwt. at 9s.)	£15,187,500
	£15,187,500

The final result, it will be observed, is *the price of bread remaining the same;* the British farmer would obtain a profit of £3,375,000, the Colonial farmer £625,000 (by means of the preferential treatment), whilst the increase of price obtainable from home-made machinery would make our engineering works busy, and, at the same time, the wages of the agricultural labourer would be increased.

The following Tables show at a glance the result of our present system of business relations:—

TABLE IV.—FALL IN ACREAGE AND YIELD WITH RISE IN IMPORTED WHEAT DURING 45 YEARS.

Cereal Years.	United Kingdom Wheat crop area.	United Kingdom Wheat crop (less seed)	Wheat and Flour imports.	Available for consumption.	Population.
	acres.	qrs.	qrs.	qrs.	
1854-55 ...	4,037	16,427	2.983	19,410	27,767
1859-60 ...	4,020	12,004	4.516	16,520	28,715
1864-65 ...	3,686	15,180	5,500	20,680	29,700
1869-70 ..	3,977	12,301	9 921	22,222	30,760
1874-75 ...	3,822	12,898	1,705	24,603	33,629
1879-80 ...	3,048	5,047	6 410	21,457	34,388
1884-85 ..	2,745	9,307	8 001	27,308	36,200
1889-90 ...	2,545	8,771	19,093	27,864	38,065
1894-95 ...	1,454	4,373	25,000	29,373	39,600
1895-96 ...	1,731	6,793	22,693	29,486	39,800
1896-97 ...	1,693	6,492	21,845	28 337	40,000
1897-98 ...	2,155	8,754	22,147	30 900	40,337
1898-99 ...	2,052	7,830	23,263	31,093	40,708
1899-00 ...	1,845	7,500	22,355	29,855	41,000
1900-01 ...	1,701	6 000	24,392	30,392	41,300

Note.—The 000's are omitted throughout the Table.

TABLE V.—FALL RESULTING FROM "FREE" IMPORTS AND TAXED EXPORTS.

	1854-1885.	1900-1901.
Area of wheat crop in United Kingdom in acres............	4,037	1,701
Total wheat crop in United Kingdom in qrs..................	16,427	6,000
Imperial wheat and flour in qrs...	2,983	24,392
Total wheat and flour consumed..	19,410	30,392
Population	27,767	41,300
Area per head of population in United Kingdom	0·181	0·041
Crop per head of population in United Kingdom	0.591	0·145
Imports per head of population in United Kingdom	0·107	0·590
Total wheat consumed per head	0·698	0·735

Now, if the production in the United Kingdom of wheat had proceeded *pari passu* with the increase of population as well as the increase in consumption *per capita*, the figures for 1900-1901 ought to have been—

	Should have been	As against
Area of wheat crop in United Kingdom in acres............	7,880	1,701
Total wheat crop in United Kingdom in qrs..................	25,727	6,000
Imported wheat and flour in qrs. .	4,665	24,392
Total wheat and flour consumed..	30,392	30,392

Obviously other figures might be taken as regards the amount of import tax to be imposed with similarly beneficial effects; provided always the duty be sufficient to ensure a fair profit for our home-farmers coupled with an adjustment, such as that I indicate, ensuring, at once, the preservation of the present price of bread with facilities for the supply of our wants by our own branch establishments.

It is with intense satisfaction I observe the suggestion put forward, during the last few days, by one of our leading politicians—Mr. J. L. Wanklyn, M.P.—that, to cope with the difficulty, *a bounty should be accorded to wheat.* This laudable proposal, without shadow of doubt, is a step in the right direction. But, unfortunately, it does not go far enough, because it is not sufficient to put British farming upon a firm commercial footing, such as we all wish to see it enter upon. If, however, the bounty be *transferred to flour*, in the way I suggest, then we immediately obtain "*the cheap loaf*," and at the same time *flourishing agriculture and well paid farm labour.*

At first sight it might appear that the foregoing is a circuitous route to an end, but it is difficult to see there is any more direct means for the complete solution of the problem *in all its bearings.* It may also be urged that, from the point of view of national economies, it is imperfect by reason of wastage in collection; but the expenditure thereby entailed would, in itself—in a two-fold measure—be beneficial, firstly because income derived from a foreign source would be employed, and secondly—a vast amount of "dumping" would be put a stop to. For it must be remembered the benefit to the purchaser of obtaining "dumped" *manufactured* goods at slightly lower price means, either a reduced rate of wage to the workers or the extinction of our industries, a process which has been going on hitherto unnoticed by the general public to an alarming degree. Moreover, such advantage is nationally far more than coun er-balanced by the also alarming cost of upkeep of our pauper population.

From the administrative point of view, the payment of a bounty upon flour would be a very simple matter; nothing more than the inverse operation — working with perfect smoothness—in regard to the collection of revenue from alcohol. The short-lived "registration duty" upon corn demonstrated beneficial effects upon our milling industries principally from the offals obtainable; capitalists came forward for the building and equipment of up-to-date *steel* corn mills. Were the proposal I make acted upon, in a couple of years our country could be doing all its own milling

and our Government inspectors would *credit* such establishment with the amount of bounty payable *to* them precisely as to-day they *debit* our breweries and distilleries with the duty payable *by* them. The labourer's loaf would cost him the value, but he would earn more money with which to buy it and other comforts.

Thus much concerning the legislative modes open to us—modes similar to those adopted by other nations which to-day do *not* find themselves in the unenviable position we find ourselves in regard to agriculture and many other industries. I must now turn to their methods of outdistancing us in regard to culture, a branch of our subject in which the establishment of Garden Cities will, I shall hope to show, be potent to play an important *rôle.* It may be be said in a word, the secret lies in the more extensive application of science to agricultural operations expressed tersely and effectively by the phrase "*intensive culture.*"

One of the many shortcomings of concentration of population in our great towns is the enormous waste of that natural wealth-producer —sewage. The waste is not, moreover, confined to the product, vast though it be, for a further and enormous expenditure is entailed in the casting of it away. It is a vast waste of what one might call the double-acting type, for, concurrently with huge payments for the casting away of a valuable entity, other huge payments have to be made in the purchase of imported fertilisers. If now we picture the face of our country becoming o'erspread with towns of moderate size, each engirdled with its agricultural zone, we see at once the practicability of effecting vast economies. The two most formidable *bêtes noires* in the path of the agriculturalist are cost of manure and cost of carriage; both of it and of the produce of the land upon which it is utilised. It is precisely this trouble in the procuration of manure and its great cost which militates so strongly against the carrying into effect of the intensive form of cultivation so necessary in regard to countries of restricted acreage.

Under existing conditions it requires at least two acres of farm land per inhabitant to feed our workers, and thus each of such Garden Cities, with a population limited to 25,000, would profitably utilise at least 50,000 acres. Now, the problem of utilising the natural fertiliser from such a City over the whole area represented by the 50,000 acres would be upon an entirely different footing from that of its useful and profitable disposal from towns inhabited by *millions* over an area of *proportionately greater* extent. Hence is paved the way for more rapid and intensified culture, but the latter means, at the same time, augmentation of the labour-supporting capacity of the land. Agriculture at present suffers from dearth of labour, whilst our cities are overcrowded by it, the reason being explained by the fact that the land at present finds the payment of a higher rate of wages a burthen greater than it can bear. But the condition is altered by the degree of cultivation. Hence we are justified in saying that the establishment of these Cities will in a great measure solve the agricultural problem.

Time will only permit of my touching, and that very briefly, upon a couple of examples of intensive agriculture. I will take the rearing of cattle and market garden practice. The former I have chosen because it brings out in a surprising manner the value of sewage irrigation, whilst in regard to the latter the effect of the application of science to intensive culture is little less than astounding.

Corn-growing we know has gone from bad to worse year by year, until, we are told, it no longer repays for the labour expended on the production of the grain. It has, therefore, as we have seen, been largely abandoned—under existing conditions an inevitable result. But, I would ask, "were any really determined efforts made upon any large scale to mitigate the state of things by means of intensive cereal culture?" I am afraid the answers is in the negative! Yet there is evidence much *might* have been done.

Some years ago Major Hallett devoted his attention to the selection of the seed grains of wheat and to the individual planting of each grain, as opposed to the "broadcast" scattering methods usually employed. This investigator obtained, on the South Downs, results as valuable as they were extraordinary. He found that, were "room to grow" allowed to it, a single grain of wheat would throw up and nurture no less than from ten to twenty-five separate stems each bearing an ear of corn; moreover, that each of such ears, instead of containing the usual 60 to 68 grains produced at least double that number. A single grain of seed, therefore, produced from 250 to 2,500 grains instead of from 120 to 180 grains. These interesting experiments of Major Hallett's—it need scarcely be said in our country, so oblivious to the practical value of science—were received with much doubt. A few, however, applied to him for seed, and sought to obtain similar results,

The effect leads one to point out that scientific research and experiment should only be entered upon by those prepared to tackle all the minutiæ, and not to be deterred by one or more failures; for that was how the few tests made elsewhere ended, the causes being readily explicable. Indeed, it may be said that failure was insured from the outset. The seed, well adapted to the chalky soil of the Downs, was unsuitable for the other soils; the time of planting, which should have varied with the locality, was unconsidered and—indeed, in no case, albeit the conditions were *dis*-similar to the original experiments, were proper compensating deviations made.

With characteristic despondency, therefore, the matter was allowed to drop, so far as our country is concerned. But, therein lies the point of interest. For the subject was taken up abroad by Prof. Desprez and also Prof. Grandeau, each of whom made experiments in the single planting of wheat grains, and each obtained extraordinary results similar to those of Major Hallett. Desprez asserts that an average yield of 600 grains for each grain planted is *easily attainable;* Grandeau indeed, gives instances of a yield of 2,000 to 4,000 grains for each seed planted. Such results as these are surely all that is wanted to impress us with both the value and the enormous potentialities of applied science, yet, unhappily, this is appreciated little throughout our country.

No such efforts, as undoubtedly were necessary, were made with any earnestness for upon any scale to warrant success; hence a larger and yet larger portion of our country has been put down into permanent pasture. From the deductions I have made in the first part of this paper it is shown the change would have been a prudent one had the pasture land been utilised for other purposes than it has been. But such grass-land is now used to a too great extent for the production of meat, seeing that it would be wiser first to fulfil our own dairy produce requirements, and to look to our colonies to fill the increase of shortage in cattle-breeding.* In this connection, again, we would do well to ask ourselves if we are obtaining the best results and the maximum yield from our pasture-land. It has been estimated that with us it requires from two to three acres of such pasture to feed an ox for a year. Hence, allowing one ox as the animal food for every three persons in the country—a very fair average—we find that our thirty-two and a-half millions of inhabitants would require the same number of acres for the raising of their beef alone, whereas the total cultivated area of Great Britain is only some thirty-two and three-quarter million acres, half of which is permanent pasture, and the other half cultivated land proper, including under this head land under rotation of grasses and that cropped for hay.

Is this a parallel condition with other countries? If we turn to Belgium we find that one and a third persons per acre are supported entirely on the agricultural products of their own country, irrespective of their exports (*amounting to more than a million pounds sterling*) of such products to this and other countries. Moreover, Belgium, be it remembered, is a country having a much larger export of manufactured goods per head of population than our own.

One is justified in asking how this fine result is brought about. The answer given by the Belgian farmers is, that they are compelled continually to study how to make the land yield larger crops, and that in regard to cattle-rearing they have succeeded by *substituting a cultivated feed* in place of *permanent pasture*. The effect of scientific treatment in this connection is truly astonishing. This is clearly demonstrated by the work of a celebrated French writer on agriculture. He assumes that 9,000 lbs. of dry hay are necessary per head of horned cattle per annum, and by the following Table shows the rearing capacity of the land by the substitution of "cultivated feed":—

TABLE VI.

	Crop per Acre in Pounds.	Equivalent in Dry Hay in Pounds.	Number of Cattle fed from every 100 Acres per Year.
Pasture	—	1,200	13
Meadows under hay	—	2,400	26
Clover cut twice	—	4,800	52
Swedish turnips	38,500	10,000	108
Water irrigated meadows (France)	—	13,440	145
Rye grass	64,000	18,000	180
Beet (intensive culture)	64,000	21,000	216
Sewage irrigated meadows	—	22,400	242
Indian corn ensilage	120,000	30,000	330

* The Agent-General for Queensland, speaking at the London Institution recently, said Australia was willing to take all the produce that England could manufacture for them, but the business must be kept in the family. Nobody had a higher opinion of the wealth of Canada than he had, yet in one year after the drought which they had experienced, Australia hoped to turn out as much ahead as Canada. Canada could turn out ten times as much wheat, as she was the national granary of the Empire, and when she did do it, Australia would, with ease, provide meat and dairy produce for the Empire, because the climate is well fitted for the cultivation of such products.

From this we are able to appreciate the enormously favourable reversal that is made to take place, for from the two to three acres required by us per head of cattle, it is possible to *reverse the figures* and so reduce the area necessary that *each acre suffices for the rearing of three head of cattle.*

If we turn to France or to Italy we shall find similar triumphs have to be recorded in regard to cattle-feeding by recourse being had to "irrigated meadows." The system was first adopted in the Vosges district, and it was found that the crop of hay rose from an average of $1\frac{3}{4}$ tons per acre to *six tons per acre.* The value of the experiment being appreciated, it spread, during the years 1862 to 1882, over nearly the whole of France. By this means land in some districts increased in value as much as five times, and the system became extended to corn and root growing land as well as to market-gardens. In Italy, around Milano, some 22,000 acres are irrigated with water derived from the sewers of the city; there, 8 to 10 tons of hay per acre represents the average crop, and on certain meadows as much as 18 tons per acre have been obtained.

I have quoted these exceedingly interesting figures with the object of impressing the vast potentialities of Garden Cities in regard to the economics of national wealth production, for it is clear that by means of decentralisation and the overspreading of the country with towns of moderate size, each separated from the other by an appropriate extent of agricultural land, the requirements of natural law involving the complete ultilisation of excrement in regeneration could be complied with. This would be accompanied, not only with vast national economy due to the process *per se*, but would enormously increase the acquisition of national wealth by means of the increase of productiveness of the land. But increase of productiveness is synonymous with increase of employment of land-workers, and hence represents another great source of national wealth by the utilisation of, *instead of forfeiting by emigration,** the work-worth of the human units produced and maintainable by the cultivation of the soil. In this relation, let it never be forgotten that the wealth of nations is not represented by money lying in banks, but that it resides in the muscular tissue and cerebral matter of the nation's workers.

In order that we may be quite clear as to the vast scope we have for "intensive culture," I have set out the quantities of market garden produce, requisite to make good the shortage of our home consumption, we are, to-day, forced to obtain from beyond the confines of the British Isles—*the product of foreigners.*

Is it not a spectacle, as surprising as it is humiliating, that garden produce raised upon the outskirts of Continental towns, should be sent to us in enormous quantities, and exposed for sale in London markets alongside our own produce raised within a five-mile radius of the metropolis? One must needs ask the reason. At first thought one might be inclined to attribute it to lower rentals of the land. Here we should fall into an egregious error, for the fact is, that an enormous amount of market-garden produce reared, for example, upon the outskirts of Paris is grown upon land the rental of which is from *six to ten times* greater than even the high priced land around London. Then it might be thought that the entities sent to us were such as we could not ourselves conveniently grow. Here, again, we should be wrong, for we are brought face to face with the fact that Germany, Holland, Belgium, and France grow for us such every day produce as *potatoes*, for which we pay them upwards of *a million sterling* every year. These countries also send us such characteristically easily grown edibles as *onions*, for which we pay them considerably over *three-quarters of a million sterling.*

How, then, are these astonishing facts to be explained? The answer is that the successful competition of the foreigner is due entirely to the *intelligent application by him of science to culture.* Time will not permit of my going into technicalities, but I cannot refrain from mentioning one fact. One constantly hears the lament that our soil is not good for this or for that. The fact, however, remains that, taken as a whole, there is probably no more fertile land in the world than that of the British Islands. The fact, moreover, is that whilst we take the land and leave it much as we find it, the *intensive agriculturalist makes his own land for himself*, for, strangely enough, much of the land upon which the finest results are achieved is intrinsically bad land. Too much is said among us of the "poorness"

* Emigration is now taking place at the enormous rate of about 20,000 per month, the wastage being replaced in unhappily large proportion by the incoming of undesirable and indigent aliens, and the refuse of other nations at the rate of 5,000 per month. In Ireland rural industry largely preponderates, and it is significant that the result of half-a-century of "free" trade has had the deplorable effect of reducing the population of that portion of the British Isles to about one-half.

of the soil. To the scientific horticulturist the soil is but a vehicle. The science-trained culturalist will *manufacture* his soil, a mixture of sawdust, old hemp, and leaf mould serving him very well. He finds that with machinery he can make any soil, and of any desired composition. To such an art has this already been carried by our competitors, that it is now a usual stipulation in the contracts of tenure of the French *maraîchers* that the market-gardener may, on quitting his tenancy, carry away with him his soil down to a stipulated depth. I have referred to the value of land in proximity to towns due to the facility of procuring stable manure. But your scientific horticulturist argues out the thing scientifically. Such manure he argues is put upon the land, principally for the purpose of warming it, and he finds other and more efficient means of thermal treatment, for in many instances he runs pipes through his thus manufactured land and heats it thermo-syphonically.

The result of all this is that the land is made to yield a hundredfold what we extract fro m it and by this means the foreigner is enabled to send his produce, paying freight for carriage hundreds of miles *to us* ,and to live in his own capital upon the profits earned by the sale of his produce in ours. On this point, it is obvious Garden Cities will stand at great advantage, for their establishment will annihilate the trouble—the cause of such vehement outcry —the cost of carriage.

What then, we are forced to ask, is the weak point in our own system which at once puts us in a position we ought not to occupy and enables foreign competition to be so successfully carried on. Obviously it is the want of proper means at our disposal for imparting scientific training to our agriculturists. A word upon this must suffice to conclude my reference to this interesting and important subject of intensive culture. Time will not permit of my drawing analogies with the superior systems possessed by other countries, but I will just touch upon the manner in which the desideratum has been fulfilled in the United States and in our dominion of Canada; because I am anxious to show that by means of the establishment of Garden Cities similar results might be attained by us in a very economical manner. It is sometimes erroneously assumed that upon the vast acreage there tilled, a low standard of culture is resorted to ; that indeed with more propitious climatic conditions, it is only necessary to cast seed upon the land for satisfactory crops to result as a matter of course.

This is how things first commenced, but the land was found soon to become exhausted of its nourishing properties, and with this low degree of culture the crops obtained were small and the soil so materially deteriorated that, had this method obtained for long, and been persevered in, America would soon have ceased to be a competitor in the grain market. The Government, with laudable prevision, recognised this, and advocated the substitution of scientific farming for the more or less rough-and-ready methods. To this end the Senate, in 1861, voted a land grant consisting of 30,000 acres to be set aside in each State for each senator and representative in Congress to which the State was entitled. By this Act 9,600,000 acres of land were appropriated. Some of this was sold, the money so obtained being invested—as required by the Land Grant Act—in safe security, and the income devoted entirely to the maintenance of land, to the erection of colleges and other buildings, and repairs thereto, such to be utilised in the improvement of land culture and the teaching of agriculture. By the year 1882 there had accumulated some 9,000,000 dols. Besides the land unsold, the buildings, apparatus, and grounds used as experimental farms or colleges, were then valued at 6,531,844 dols., making a grand capitalised value of no less than 15½ million dols. But the result to American agriculture is scarcely to be estimated, being out of all proportion to any expenditure that may have been incurred. Colleges for technical instruction and agricultural teaching have been thereby caused to spring up throughout the length and breadth of the land. Experimental farms exist everywhere. The farmer has, at his command and disposal, the entire results of years of patient study and the hard toil of men whose constant duty it is to grapple incessantly with the problems of how to produce the utmost from the soil, and never to be satisfied with a "good crop," but ever to strive for a better. The local farmer has not to learn from men well versed, it may be, in theory, but who have never seen that part of the country cultivated by him, for there is a college at his door, as it were, a practical establishment in actual work, competing indeed with himself for good results, yet all the while showing him and proving to him by demonstration how best to farm his own land. The farmer's son is not limited in his education to the generalities of agriculture, but he also learns and makes practical acquaintance with

the particularities of the soil he will have to cultivate when he shall return to the paternal homestead, such instruction being imparted to him by men who have made the soil of that particular district the study of their lives.

Turning to Canada we find on such lines as these was also founded the Canadian Experimental Farm at Ottawa, perhaps the most perfect of its kind extant. By the courtesy of the Canadian authorities I have been furnished with exhaustive details of their system, which happily has proved so successful. Here I must contend myself with pointing out that succes has resulted from two principal factors of the system, first, that financial aid commensurate with the importance of the problem was provided; secondly, that *local instruction*—so valuable in this connection—is afforded.

Now if we picture to ourselves, in place of a heavy expenditure and the establishment of a great central model farm, our country becoming gradually overspread with Garden Cities, each provided with their own belt of agricultural land, we can at once appreciate how potent such cities will be to play a most important part in regard to our agriculture. Each city, it need scarcely be added, will have its own polytechnic and technical college, and if the instruction be properly carried into effect — efficiency and practicability being the watchword—the students of each, sons of farmers tilling the environing lands, will be *theoretically* taught within the college walls, but *practically* instructed upon the very land they are called upon to cultivate,

I have spoken of amelioration by means of legislative modes and by the more perfect application of science to culture; I trust, moreover, I have shown that the establishment of Garden Cities would bring us nearer the realisation of the profitable utilisation of sewage and the welding up of the, at present broken, cyclic of natural law disturbed by the artifice of man; I trust, moreover, I may have demonstrated that the Garden City system of housing both populace and trade would obliterate the, at present existing, trouble due to *freightage* and *merchandise transport*. Obviously it would, at the same time, overcome the grave, and ever increasing, difficulties of urban *personal* locomotion and the mechanical transport of human beings from dwelling to place of occupation within the bowels of the earth.

I now desire to direct attention to another valuable result to accrue from decentralisation brought about by the disposal, throughout the country, of hygienic cities, limited as to population, and each provided with its girdle of market garden and agricultural land. This effect—of enormous national importance—would be due to the so-much-to-be-desired *interweaving of agricultural with urban industry*, such re-adjustment of terrestrial collocation of populace would render possible.

To explain this, I think I cannot do better than take a concrete example of such interweaving; this I will do in connection with an industry—unhappily at present non-existent in our country—albeit of vast importance to other nations, one typically illustrative of the interweaving to which I refer.

Through the instrumentality of the recently concluded Sugar Convention—a laurel in the crown of our present Government—it is now practicable to re-introduce into Great Britain the important industry of sugar manufacture, an industry, through singular neglect, we have allowed to become gradually and entirely extinguished. Very cursory reflection will serve to show the great value of the interweaving of factory industries with agriculture, but there is nothing existing in our own country at the present moment in any way comparable in national importance, with the mutual interworking practicable in regard to the sugar industry, and I venture to bring it forward for the very earnest consideration of financiers and the well-wishers of our nation.

Happily, in regard to the agricultural side, all the necessary experiments have already been gone through. Happily, moreover, the trials and tests have proved thoroughly and gratifyingly successful. As to the industrial side, absolutely no difficulty presents itself. It will, therefore, be only necessary for me to touch upon the agricultural department of the vast industry, namely sugar-beet culture.

That the experimental stage has been successfully passed through, is due to the hearty co-operation of a number of our leading agricultural authorities with an expert who has displayed singular energy and perseverance in the accomplishment of his object. I refer to Mr. Sigmund Stein. The results of the labours of these pioneers I am enabled to lay before you in tabular form and I hasten to add that, by their laudable work, they have been able to explode entirely the fallacy that the land and climate of the British Isles is unsuited to beet culture. Those who seem to delight in raising difficulties and in endeavouring to defeat efforts to increase the prosperity of their own country have either scouted the notion or

pointed out, entirely without authority, that the sugar-beet could, at most, be grown only in our southern counties. I will ask you to glance at Tables A and B (Supplement), from which you will learn some surprising facts. In the first place you will observe that far from the successful culture being confined to our southern counties, sugar-beet culture has been successfully carried on from Hampshire in the south of England to Aberdeenshire in the north of Scotland; whilst in Ireland the results have been thoroughly satisfactory. It is observable in regard to beet culture that science within reason has as much to say as the sun, or the latitude. We see, for example, in regard to the south, that, under the able supervision of Mr. Moens, the Hampshire yield was the excellent one of 19 tons for a crop raised in 149 days. But if we go to the other extreme, we see in the north an excellent yield was obtained in exactly the same number of days; the northern yield, however, fell short of the southern by some 20 per cent., but then one must carefully observe the fact that the degree of culture also fell short. In the first place the amount of farmyard manure put on to warm the land was only one half; whilst the more scientific or specific treatment was not had recourse to at all. What the effect would then have been is deducible from another Scottish test (Table A, No. 39); there we see that a treatment by dissolved bones immediately raises the yield from 15 tons up to 17 tons, the number of days remaining substantially the same. Excessive rainfall, moreover, it is gratifying to observe, in regard to sugar-beet farming proves no formidable enemy, for we find in the west of Ireland the crop can be grown at good speed and with a fine return by means of ordinary farmyard manure.

This I trust effectually explodes and disposes of the fallacy to which I have referred, showing, as it does, not only that we can raise all the roots we may require, but that the *quantity produced per acre is thoroughly satisfactory*. Now let us turn to their *quality*. Turning to Table B (the reference numbers in which correspond to those in Table A), showing the analysis of the beets grown, we learn from the grand total of the results a fact as surprising as it is gratifying, namely, *in every respect the quality of British-grown* sugar beetroots is *superior* to those grown in Germany, one of the greatest of sugar-producing countries. These results will be found summarised at the foot of the Table, and I must not omit to direct especial attention to the figures in the first column, for two things might be passing through the mind of the observer, firstly that the British beet might be little and good, and secondly that even if during the tests they had not been pampered the result might be due to *virgin soil*. Happily the figures at once dispose of any such suggestion, the weight of the British roots being surprisingly greater than the German, getting indeed into the neighbourhood of double the weight. With regard to the effect of virgin soil, fortunately one is able to dispose at once of any such illusion; and it is a source of much gratification to me, upon such an important subject, to be able to impress upon you the important fact that the work of these pioneers—to whom I feel you will agree we owe much—have in many cases followed up the work year after year, and we have only to note the fact that the fine results to which I referred at first—those of Mr. Moens—were obtained from *land continuously under beet cultivation for a quarter of a century*. This authority informs me that he has grown the roots for over 30 years, principally for his cows, and that the *crop has never once failed*. The summary referred to in Table B (Supplement) was that of the results of 42 tests in a single year. If, however, we look at Table VII. we find that the results are equally satisfactory when spread over a series of years.

TABLE VII.—ANALYSIS OF ROOTS.

Year.	Country.	Average Weight of Root with Leaves in Grammes.	Average Weight of Root without Leaves in Grammes.	Degrees Brix (Dry Matter).	Specific Gravity.	Quantity of Sugar in 100 Parts of the Juice.	Quantity of Non-Sugar in 100 Parts of the Juice.	Quotient of Purity.
1897	British	1,229	804	18·44	1·076	15·80	2·64	85·64
	German	1,148	561	17·81	1·074	15·07	2·74	84·05
1898	British	1,371	843	19·05	1·079	16·54	2·51	86·82
	German	974	539	19·02	1·079	16·32	2·70	85·80
1899	British	1,644	902	19·00	1·079	16·30	2·70	85·78
	German	957	611	18·30	1·076	15·45	2·85	84·42
1900	British	1,525	790	19·52	1·081	17·07	2·45	87·45
	German	1,064	557	20·00	1·083	17·38	2·62	86·90
1901	British	1,441	851	19·38	1·180	17·02	2·36	87·82
	German	1,112	621	17·66	1·073	14·76	2·90	83·53
1902	British	1,326	878	19·28	1·080	16·80	2·49	85·11
	German	1,042	492	17·43	1·072	14·79	2·64	82·74

I trust the figures shown and quoted will serve to prove, not only that the sugar-beet *can* be grown in England, but that when grown it is actually superior to the foreign-grown product, possessing as it does a higher percentage of saccharine—the entity for which it is grown. Furthermore, that it is superior in its quotient of purity and in the actual weight of the root, these valuable advantages being combined with the desired smaller percentage of "non-sugar." It will be observed that the average crop may well be taken to be 16 tons of roots per acre, and this again compares very favourably with the average crop obtained upon the Continent. Even this in all probability, seeing that up to the present time there has been no call for the extensive cultivation of the sugar-beet in Great Britain, may be improved upon, and it may be interesting to mention that in Canada experiments have been recently carried out, with the result that an average crop of no less than 26 tons per acre has been obtained with seed sown early in May, and 23 tons with seed sown towards the end of May. Beet culture requires appropriate care, but presents no particular difficulty. Certain points should receive attention, and these are now known and understood; for example, in the Canadian tests just referred to it was found that if the root were covered with earth, so that none of it, save the leaves, was exposed, it made a considerable difference in the percentage of sugar. In beet cultivation, as with every other form of agriculture, the enrichment of the soil should be apposite; thus, it is to be remembered that the amount of nitrogen influences the amount of crops per acre, phosphoric acid effects the quotient of purity, whilst potassium is in a certain ratio to the saccharine richness of the roots. As will be seen from the Table (VIII.) the leaves are largely responsible for the

TABLE VIII., SHOWING FOOD SUBSTANCES EXTRACTED FROM THE SOIL BY 1,000 POUNDS OF BEET AND LEAVES RESPECTIVELY.

Food Substances.	Beets.	Leaves.
	Pounds.	Pounds.
Nitrogen	1·5	4·0
Magnesia	0·7	2·6
Phosphoric acid	1·0	1·5
Potassium	3·5	5·9
Lime	6·8	16·3
Totals	13·5	30·3

extraction and retention from the soil of the food substances, hence the sliced off heads may with advantage be returned to the land and ploughed in. Against this it has been usual upon the Continent to use these as foodstuffs for cattle, with considerable benefit, and to make up the loss by ploughing in the requisite extra amount of manure.

It now, I think, only remains for me to touch upon the interweaving of the work of the sugar factory with that of the agriculturalist, and to conclude by showing the practicability of introducing the vast industry into Great Britain, and to touch upon the enormous national benefit which could be made to accrue.

The interweaving of this industry with agriculture to which I have referred is, of course, dependent upon whether the growing of beet will prove profitable to the farmer. Happily, again, the long series of tests prove this most satisfactorily and conclusively. The question is answered in a practical manner by the results obtained, not only in a single year, but by those obtained from cultivation year after year; and these not confined to one or two growers, but by a number of eminent agriculturists, and on land spread over a great area of our country—land extending hundreds of miles farther north than the latitude above which, we were gravely told, beet culture would be an impossibility.

The farmer, having hauled his crop of beets, cuts off their heads, thus securing the first bye-product, for these as already mentioned are good for feeding cattle. He then delivers his crop to the factory, where, during the process of manufacture, they are sliced into very fine slices. Of these the farmer subsequently receives back nearly a quarter—after the saccharine matter has been expressed—equivalent to some three tons for each acre's crop. This "pulp" is a most valuable feeding-stuff. In a subsequent process the saccharine liquor is treated with lime, and a residuum—called lime-cake, or saturated lime—is produced, and this the farmer also takes and uses as manure.

In the two following Tables, the first gives the cost per acre of sugar-beet growing, whilst in the second is seen the return from beet crops of 15 tons to the acre.

COST OF GROWING SUGAR-BEET PER ACRE.

	£	s.	d.
Rent and taxes	2	0	0
Clearing and forking weed stubble	0	1	0
Ten loads of farmyard manure	1	10	6
Carting 10 loads of fresh manure	0	5	6
Spreading manure	0	1	0

Cost of Growing Sugar-Beet (continued).	£	s.	d.
Ploughing 9 to 11 inches deep	1	0	0
Cultivating, including harrowing and rolling	0	6	6
Artificial manure	1	10	0
Sowing	0	2	6
Seed—30 pounds	0	12	0
Drilling	0	1	0
Hoeing and thinning	0	10	6
Harvesting	0	12	9
Carting to factory—15 tons, three miles, at 6d. per mile per ton, and 3d. per ton labour	1	6	3
	£9	19	6

Or say £10 per acre.

PROFIT AND LOSS ACCOUNT PER ACRE.

Dr.	£	s.	Cr.	£	s.
Cost per acre to plant, cultivate, harvest, and deliver roots	10	0	Receipts for roots, 15 tons, at 18s. per ton	13	10
Profit per acre	6	10	Value 5 tons leaves and heads from roots	1	5
			Three tons slices, 20 per cent. of quantity delivered, at 10s.	1	10
			Value saturation lime	0	5
	£16	10		£16	10

The price here quoted—viz., 18s. per ton—is a fair average price for sugar beetroot. Now, at this figure, we see that from these alone the farmer makes £3 10s. per acre profit; but, according to Mr. Stein, the value of the heads and leaves as feeding-stuffs is 25s., that of the slices, returned free from the factory, 30s., and that of the saturated lime for manure, 5s. It is unquestionable that these heads, as well as the thin slices of beet remaining after the sugar has been extracted, have great value as feeding-stuffs for cattle. This fact has been demonstrated, both experimentally and in actual farming, in every part of the Continent. It is a convenient food also, for the leaves may be compressed—with or without salt—and kept for many months as winter food, the slices also being obtainable from the factory during the winter months, when fodder is at its dearest. The feeding of cattle in combination with sugar-beet growing, it must be mentioned, gives the necessary amount of manure required for the crop. Moreover, the deep ploughing and careful culture, together with the necessity for proper manuring, required by the sugar-beet field, increase the cultivative value of the land for all succeeding crops. Although, for the sake of safety, the average crop has been taken in the Tables at only 15 tons per acre, there is little doubt that, with proper attention to such points as the seed best suited to the district, the time of planting, and the hoeing processes, much better average crops can without difficulty be produced.

Thus it will be seen that there is an interweaving of the interests of cultivator and converter, of farmer and manufacturer, beneficial to each, and also to Garden Cities, if these be laid down upon scientific lines, as I venture to suggest should and indeed must be the case if these are to be anything more than philanthropically "bolstered" schemes of local land development. For the manufacturer requires much heat for boiling and evaporating: this the City would supply him in the form of cheap gas. But the farmer requires far more manure than the "lime-cake" affords; here again the City could supply his wants to mutual advantage in the form of sulphate of ammonia, one of the by-products in the manufacture of their non-illuminating fuel gas.

It is also to be assumed that Garden Cities will have their sewage farms, and these run upon the best and most modern principles. In this case, again, an interweaving could be effected, the requisite trials having already been carefully and exhaustively carried out by the city of Liverpool, under the able supervision of Mr. John A. Brodie, M.I.C.E., the city engineer. The results of some of this sewage-assisted cultivation are enabled, so to say, to speak for themselves by means bf their photographs. Sewage disposal in inland towns is a problem increasingly absorbing the attention of engineers, and it is therefore most gratifying to find the highly satisfactory measure of success which has attended sugar-beet culture on sewage farms.

The results of beet culture by means of sewage at Liverpool are embodied in Table C (*see* Supplement). A noticeable feature of the Table is the enormous increase in the weight of the crop, whilst a gratifying feature is that, despite the great increase in weight of roots, the percentage of sugar yield should remain perfectly satisfactory. Sugar-beet has also been very successfully grown on other sewage farms, amongst them Oxford and Malvern. It has also been satisfactorily grown on other lands, using sewage as manure. The results of some of these experiments are given in Table D (*see* Supplement).

These Tables show there has been a steady increase in the size of the roots, and in the percentage of sugar in every 100 parts of the roots, from 1898 up to the present date. The reproduction of a photograph shows a group of the monster roots raised in 1902—a *bad* season—sewage being used as a fertilizer. Sugar Bounty Convention we have, placed as it were into our hands, the power, not only of recrudescing sugar refining, but of entering forthwith into the profitable manufacture of sugar.

The cost of sugar-making works out as follows:—

The Oxford sewage farm also produced in 1898 a series of really gigantic roots, the weight of which is given in Table D (*see* Supplement). The experiments made at the Grammar School, Shepton Mallett, in 1901 and 1902, are as interesting as they were successful. In the latter year no less than ten experimental plots were cultivated by Mr. W. Aldridge, at this school, all under varying conditions of manure; the results being good, both as to weight of crop, weight of root, and sugar percentage. Were we to teach our rising generation the best way to raise this crop, and show them how profitable it can be made, we should make a vast stride towards regaining our old agricultural prosperity.

I will now conclude, as I have said, by touching upon the vast importance of sugar manufacture as a national industry. By the

		£	s.	d.
Fuel, 12 per cent. coal at 7s. per ton..		0	0	10
Wages:—				
First process—preparative........		0	0	8
Second process—completive		0	0	10
Limestone, 4 per cent., at 6s. per ton delivered..		0	0	3
Coke	2·30d.			
Leather and filter cloth....	0·60			
Bags..................	1·92			
Oil and grease	0·55			
Light	0·45	0	0	9
Various materials	0·62			
Laboratory	0·56			
Selling commission	2·00			
Sundry expenses		0	0	3
Expenses of office, management, etc.		0	2	5
Total..........		0	6	0

The average weight of coal required is from 10 to 12 per cent. of the weight of the beet-

roots, whilst about 4 per cent. of their weight is sufficient in limestone, about 5 per cent. of the weight of the roots of coke being necessary for burning the lime.

With a 13·3 percentage of saccharine, 7·5 tons of beetroots are required for the production of each ton. The cost in this case of producing a ton of sugar is :—

	£	s.	d.
7·5 tons of roots at 18s.	6	15	0
Expenses of making, at 6s. per ton of roots	2	5	0
Total	£9	0	0

Taking the case of a factory capable of dealing with 40,000 tons of roots per annum its balance-sheet would therefore be as follows :—

FACTORY DEALING WITH 40,000 TONS OF BEETROOTS PER ANNUM.

Dr.	£ s. d.	Cr.	£ s. d.
Cost of beetroots, including expenses, 40,000 tons at 24s.	48,000 0 0	5,200 tons sugar produced, at £9 per ton	46,800 0 0
5 per cent. depreciation	3,000 0 0	800 tons molasses, at 2s. 4d. per cwt.	1,850 0 0
Profit	3,650 0 0	12,000 tons slices, 30 per cent. at 10s. per ton	6,000 0 0
	£54,650 0 0		£54,650 0 0

The capital expenditure necessary for such a factory to be erected in the very latest style, and equipped in a thoroughly scientific manner with all modern improvements in plant and machinery, would be £60,000. Carried on under proper scientific and technical control, this should yield a profit of £3,600 per annum, and produce a dividend of about 6 per cent.

This is not a very high rate of interest for an industrial undertaking, but in these days, if combined with safety, it would be very acceptable. Probably there is no safer industry, for sugar is a *necessity*—a great thing in business. It is, moreover, a commodity of universal consumption.

I am, however, purposely looking at the least favourable side of things all through, and it would be well to consider this point a little more minutely. The result of so doing, it will be seen, is to add to its complexion an even more roseate hue ; for we have to consider what will, in all probability, be the effect of this altered state of affairs concerning bounties upon sugar. Through the abrogation of the bounties, it is probable that the figure taken will be not only reached, but that it will be much exceeded. In regard to sugar, overproduction has, of course, been rife for some years, ; but a continental expert of large experience gives me, as his private opinion, that in future the prices ruling will be from £9 to £9 10s. a ton, once the present large stocks are cleared from the market, seeing that at that price it would produce a fair profit to the continental manufactures.

There is yet, however, another important point I must not omit to bring forward and briefly consider. It is this : that by the Brussels Convention, it has been agreed between the Powers concerned, of which Great Britain is one, that all home-grown sugar should be entitled to remission at the rate of six francs per 100 kilos—equivalent, that is, to 2s. 6d. per cwt.—from whatever tax might be levied by the country of its origin. Now, Great Britain, as a signatory of the Convention, must, when occasion arises, accord this remission to her manufacturers. At present a tax of 4s. 2d. per cwt. is levied by us upon *all* sugar. Now, *ceteris paribus*, by the above-mentioned clause the tax on home-grown sugar should be reduced by half a crown—*i.e.*, it should be 4s. 2d. less 2s. 6d., viz., 1s. 8d. per cwt.

Now, this is an important matter, for the remission of 2s. 6d. per cwt. obviously means no less than £2 10s. a ton in favour of the British sugar-maker. The full significance of this may perhaps be more readily seen and better understood if one shows the price which would have to paid by the consumer for sugar in each case.

	£ s. d.	£ s. d.
For foreign sugar, at £9 per ton	9 0 0	
With duty at 4s. 2d. per cwt.	4 3 4	
Price to consumer		13 3 4
For British sugar, at £9 per ton	9 0 0	
With adjusted duty at 1s. 8d. per cwt.	1 13 4	
Price to consumer		10 13 4
Difference		£2 10 0

This, being interpreted, means, not only that the British sugar manufacturer could make his fair profit, but that he could supply the English consumers at no less than £2 10s. per ton cheaper.

Now let us take the case of a still lower figure as the price at which continental sugar could be supplied—say £8 per ton. This,

with the duty added, would mean the price of £12 3s. 4d. to the consumer. British sugar obviously could be sold at the same figure—£12 3s. 4d., less £1 13s. 4d., or £10 10s., as the price obtained by the producer. To amplify this I have drawn up the following Table, by which is seen the price which would be obtainable for British sugar under the circumstances corresponding to different rates of prices of continental sugar :—

Continental.	Duty.	Price paid by Consumer.	British.	Duty.	Price paid by Consumer.
£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
6 10 0	4 3 4	10 13 4	9 0 0	1 13 4	10 13 4
7 0 0	"	11 3 4	9 10 0	"	11 3 4
7 10 0	"	11 13 4	10 0 0	"	11 13 4
8 0 0	"	12 3 4	10 10 0	"	12 3 4
8 10 0	"	12 13 4	11 0 0	"	12 13 4
9 0 0	"	13 3 4	11 10 0	"	13 3 4
9 10 0	"	13 13 4	12 0 0	"	13 13 4
10 0 0	"	14 3 4	12 10 0	"	14 3 4

Now let us again review the position of the prospective British sugar-manufacturer. It has been shown that at £9 per ton he could make six per cent.; but with sugar at £10 a ton the proportional increased earnings would raise his profit to 14¾ per cent., with sugar at £11 it would become 23·4 per cent., whilst with £12 sugar it would be increased to no less than 32 per cent. Even under the very satisfactory condition of things where a high rate of interest could be paid to the investor, resulting in the introduction of an enormous industry into our country, the consumer would still only have to pay about the same for his sugar as if we continue to remain somnolent, and content ourselves merely with writing cheques for a commodity we could produce ourselves.

From the foregoing facts and figures I trust it may have been shown that we now have it in our power to inaugurate and introduce a vast industry into our country. Its magnitude, however, in its full significance, may not be readily apparent to the non-technical. It is, however, brought home to us at once if we consider the enormous annual consumption of sugar in this country alone.

We consume every year 1,500,000 tons of sugar. To produce this amount would give employment to no less than 300 factories, each capable of turning out 5,000 tons per annum, and affording profitable use for twenty-four millions of capital. To grow the requisite beets, no less than a million acres of land might be brought under cultivation for this crop alone. Now, seeing that it requires a man to every five acres of beetroot farm, this would give employment to no less than two hundred thousand agricultural labourers. These vast advantages—one must not omit to point out—would be permanent gains despite their vastness, but to them should also be added the enormous benefits which would accrue during inception to our building trades and to our engineering concerns.

Turning to the reintroduction of the lost industry of sugar-refining, we find that to deal with the sugar of our own manufacture would require thirty refineries. These would cost another £3,600,000 to build and equip. Hence, the total capital value of the industry to our nation would be £27,600,000. The manufacture would enable us to pay out in wages at least £5,000,000 a year to operatives immediately concerned. But to this must also be added the wages of the men required to supply the factories with the 2,000,000 tons of coal, 1,500,000 tons of limestone, and 400,000 tons of coke, which would be consumed during the manufacture every year.

There is, therefore, no reason whatsoever why we should pay away the huge sum of *eighteen million pounds* every year—as we are now paying—to the continental agriculturists and foreign sugar manufacturers. All of this could be spent in our own country. And what would this mean ? It would mean that, by an indirect means, we should be able to resuscitate our once great, but fast-decaying, agriculture ; we should be able to pay armies of additional artisans ; and we should be able so to increase the wages of our agricultural labourers that they would be able to live in comfort and comfortable homes, such as it is intended Garden Cities shall set the example in providing.

DISCUSSION.

The CHAIRMAN said that he had been asked to read a letter which Mr. Sennett had just received from Mr. James Leslie Wanklyn, M.P.

House of Commons,
Feb. 17th, 1904.

DEAR MR. SENNETT,—I have put your interesting Paper before Sir John Colomb, M.P., Sir Henry Seton-Karr, M.P., Sir Frederick Rasch, M.P., Mr. Freeman-Thomas, M.P., Mr. Osmond Williams, M.P., and last, but not least, Mr. Henry Chaplin, M.P.

I am sorry to say that, owing to an impending Division (of vital importance to the Government), it is absolutely impossible for *any* of us to be present, as *all* of us had hoped to do, but Mr. Henry Chaplin desires me to say that as a member of the "Royal Commission on Food Supply in time of War," he has "read most carefully your most interesting paper, and will consider it carefully."

Praise from Mr. Henry Chaplin on this all-important subject is indeed praise, and I will ask you to request your Chairman to be good enough to read this letter to your audience to-night. With all good wishes,

I am,

Yours truly,

(Signed) JAMES LESLIE WANKLYN.

The subject which the paper had brought before the meeting was one of great interest, and one which would well repay the careful consideration of all those persons who were interested in the welfare of the country. The commencement of the paper very properly called attention to two most important points—the necessity of improving the physique of the population, and the necessity of providing remunerative labour in country districts. Some of the reports which were received with regard to the physique of town populations were sufficiently alarming. There was no doubt that a country-bred population must be healthier and stronger than a population bred in the smoky slums of our manufacturing towns and districts. The attention of everybody was directed at the present time towards the most difficult problem of getting the labourer back to the land for his own sake and for the sake of agriculture, the most important industry of the country. It was extremely difficult to see why we could not raise more food stuffs at home to save their being imported. He was afraid that a great deal of the reason was to be laid to the very conservative nature of the British agriculturist. There was also a considerable amount of difficulty with regard to the means of transit from place to place, though why it should be so he did not know. It seemed to him that a great deal might be done to improve matters in this respect by better organisation, and possibly the use of motor vehicles. He did not think that it was quite safe to find fault with the fact that cheap machinery had been imported into this country. The American agricultural labour-saving machinery had been of the greatest benefit to the British agriculturalist in these days, in which it was hard to get labourers. As to Garden Cities, no doubt the picture which had been drawn was an alluring one, but he did not see how Garden Cities, if they were extensively established, could perpetually remain Garden Cities. There would always be a tendency for them to go back to what was now regarded as their opposite, and in order to secure that they should remain as they were laid out, it would be necessary that they should be held by one individual, one firm, or one corporation, as in the case of Bourneville, which was held by Messrs. Cadbury, and Port Sunlight, which was held by Messrs. Lever Brothers, otherwise the owners of the land would sell it at a profit for building purposes, when a demand for it arose. The paper dealt with the question of cultivating sugar beet, and that was the reason why he had come to the meeting to take the chair. Mr. Sennett had paid him the undeserved compliment of saying that he was one of the pioneers of the sugar-beet cultivation. He was not a pioneer but only a humble follower, for it was only five years ago since he commenced experiments on the subject. After reading about the experiments of others he realized the fact that nobody, as far as he could find out, had carried on experiments with regard to growing sugar-beet in the centre of England, or anywhere near to the locality in which he lived—namely, Warwickshire. Having looked into the matter he felt that it was highly necessary, and would be interesting to be able to ascertain, first of all, whether sugar-beet could be grown in a great number and different parts of the country on varying soils, under varying conditions, and in varying seasons. He began experiments in a small way on a few plots on different portions of his estate, haviug various kinds of soils, and the result had been encouraging. He then asked his tenant farmers to undertake some experiments for him, because there were some persons who always regarded what were called "landlords' experiments" with a certain amount of suspicion. He asked some of his tenants to grow half an acre or an acre of sugar-beet in the middle of a crop of mangolds each year. Four tenants had carried on the cultivation for four or five years, and the crops had been weighed, examined, and judged, and he had given the growers prizes to stimulate their interests. He gave the growers the seeds and the manure, and he left them a free hand to cultivate the roots as they thought well, on the understanding that the cultivation was to be of the ordinary kind such as would be pursued supposing that the cultivation formed part of the commercial scheme. The result had been mos interesting and very satisfactory. The roots had been analysed and reported on each year by Mr. Sigmund Stein, of Liverpool, who was well known as a gentleman of great knowledge on the subject. The roots which the tenant farmers had grown under the circumstances which he had described, had been in almost every year superior to the best roots grown in the neighbourhood of Magdeburg in Germany. They had been grown on light soil, heavy soil, clay soil, and loam, and no practical difficulty had been found in the cultivation. The growers had had an interesting experience, from the fact of the last two summers having been very short of sunshine. One argument which had been used in opposition to the cultivation of sugar-beet, was that this country was unsuitable for the purpose, because the cultivator could not be certain of getting sufficient sunshine; but, notwith-

standing the fact that the last two summers had been very deficient in sunshine, no appreciable difference in the saccharine qualities of the roots had been discovered in consequence of the dulness of the weather in which the crops had been grown. He thought that the experiments which had been carried on all over the country had conclusively proved that sugar-beet could be grown here satisfactorily, and he believed that it was acknowledged that if the root could be properly grown it would form a most profitable crop, and bring a great deal of employment into the country districts. The cultivation would, he believed, bring such a good profit that the farmer would be able to pay sufficiently attractive wages to the labourers to induce them to remain on the soil. At the present moment, however, we were going round and round in a kind of vicious circle. The farmers refused to grow sugar-beet, because they said that there was nobody to sell it to, and manufacturers on the other hand hesitated to come forward and put down the necessary capital for producing sugar, because they said that there was no sugar-beet produced for them to operate upon. Hitherto there had not been sufficient certainty with regard to the profits of the cultivation, for as long as the sugar bounties existed, the English farmer did not know how soon the foreigner might cut prices against him; but now, thanks to the Sugar Convention, there was a much more certain prospect of profits. Provided a proper price could be obtained for the sugar which was manufactured from the beet, he did not see why manufacfacturers should not find sufficient money to go down to certain districts and arrange with the farmers to grow sugar-beets for them for five years, and guarantee the farmers a certain price for the produce. If a start was made, and one factory could be shown to be successful, it would not be very long before other manufacturers would follow the example. Now when the import duty on sugar was imposed, no power was taken to impose an excise duty, for there was no sugar produced in this country. Considering the great importance of giving this industry a fair start, he thought that the Chancellor of the Exchequer might be fairly asked to undertake that no excise duty should be charged on home-grown sugar, at all events for a certain number of years. At the present moment, without some such encouragement from the Legislature, prices were so low that capitalists, he feared, would hardly be willing to risk their money. It was shown by a recent statement, that a departure of that sort had been made in the direction of tobacco, which was about to be grown in Ireland. There was to be a remission of one-fourth of the tobacco duty, in favour of the Irish tobacco. Why should not some arrangement of the same sort be made with regard to sugar produced from sugar-beet grown in England? He sincerely hoped that, now sugar had been put upon a more stable basis than it was formerly, something would be done to enable growers to make sure that sugar-beet cultivation could be engaged in as a profitable branch of agriculture and industry.

Miss EDITH BRADLEY (Warden of the Lady Warwick College) said that she had been struck by three points in connection with this subject. One was the system adopted by the American Government for fostering agriculture; another was the relation of Garden Cities to the women trained in the Lighter Branches of Agriculture; and the third point was the cultivation of the sugar-beet. A pamphlet written by Sir Edmund Verney, entitled, "American Methods," reprinted from *Chambers' Journal*, gave an account of the number of agricultural colleges in America, and the writer remarked that the determination of the American people to succeed in agricultural pursuits had become a national enthusiasm. In 1901 there were upwards of 40,000 students in the agricultural colleges in America. The American cultivators were competing seriously with the British farmer. It was a very curious thing that the English Board of Agriculture and the Government generally gave such very little assistance to agricultural colleges, and especially to colleges for women. Indeed, no help whatever was given to the agricultural colleges for women, and those institutions were not even officially recognised. The Swanley Horticultural College had been in existence for over ten years, and Lady Warwick College for six years, but, for some reason, all help from the public funds had been withheld from them. She believed the reason was that men thought it was only a fad for a woman to take up the lighter branches of agriculture, and that they would drop the subject as soon as they left the colleges. Such, however, was not the case. She knew from personal experience that women were doing admirable agricultural work as a result of their college training. For instance, one lady who had been to an agricultural college was now managing a large dairy on an estate where a great deal of cheese and butter were made, and she went to market and dealt directly with the factor, and sold the produce to excellent advantage. Another of the former students was now forewoman in a large nurseryman's establishment where the introduction of new varieties was the chief work carried on. If the Government would only foster agricultural training, either for men or for women, on the lines followed in America, very satisfactory results would be obtained, and the scientific training which Mr. Sennett had spoken of would go hand-in-hand with labour. Mr. Sennett had purposely used the word "artisan," rather than "labourer," to designate the agricultural worker. Might she not, therefore, plead for educated women also as being useful in helping to arouse an interest in agriculture, and in carrying out some of the suggestions which Mr. Sennett had made with regard to applying science to agriculture? As, for instance, research work with regard to plant diseases? If Garden Cities were ever established largely, it would

be a distinct advantage to have scientifically trained women to assist both in the gardens and in the dairies. Women were acknowledged to be better than men in dairy work. As to intensive cultivation, that, of course, was just the sort of work that women could do. There was one stock question she was always asked, Do students at the college learn to dig? As if that were the end to aim at for everything agricultural. The answer was, that they could dig, but it would be obviously a mistake for them to spend their strength in heavy physical labour, when they could be using their brains for the advantage of agriculture. The chief thing that women suffered from was lack of money. If they could get together two or three hundred pounds each, that was often all they had with which to make a start. A report made by Mr. Leacock on the market gardens of Evesham showed that it was quite useless to expect any return from an acre of land, unless the holder was prepared to spend £25 or £30 upon it; this, of course, meant a considerable outlay. If the Garden Cities could help women by lending them capital at a fair rate of interest, women would put their best energy and thought into the cultivation of their holdings and bring about surprising results. She believed that there would be no difficulty about women growing sugar-beet and carrying on the intensive cultivation of which the paper spoke. That industry would, she thought, constitute a very important opening for the work of women. There were many more possibilities of life in the country than in the towns, and life in the country was much healthier and better, therefore surely the race would be improved if women could have the physical advantages of the country.

Mr. Howard D. Pearsall said that the Chairman's apprehension that the owners of land in the proposed Garden Cities would be able to sell their garden ground for building when there was a demand for it, was an unfounded one, the property would be vested in trustees, and the trustees would carry out the principles of the Garden City scheme in perpetuity.

Mr. Ernest P. Woolf said that, after hearing the almost exhaustive paper which Mr. Sennett had read, they required some little time in which to digest the statements which it contained. As to Garden Cities, the idea was not a new one, but he believed that it was a good one. If produce could be grown in the immediate neighbourhood of the manufacturing districts, the cost of the railway transit would be avoided. He believed that the nationalisation of railways would be of great advantage to agriculture. It cost him, as an earthenware manufacturer, as much to send a crate of earthenware from Staffordshire to London, as to send it from the Port of London to Australia. He agreed perfectly with the author as to the flour bounty. It could be arranged in the same way as the revenue from alcohol. As to the 7s. import duty on imported Colonial wheat, as against the 9s. duty on American, he questioned whether our colonists would be satisfied with the 2s. preference.

Mr. A. R. Sennett, replying, said that he did not agree with the proposals for sweeping schemes which could never be carried out, such as the nationalisation of railways. The reason that people could travel in such comfort from London to Edinburgh was that there was competition among the railway companies. Let competition be taken away, and progress would be retarded. The difficulties which Lord Denbigh had raised with regard to Garden Cities would be obviated by the property being put into trust, and all the profit earned beyond the 5 per cent. to be paid to the shareholders being applied for the benefit of the whole community itself. But, so far, the promoters and directors of the proposed "First Garden City" seem to have closed their eyes to the benefits of science. Unless they were prepared to build their city with all the latest means of economical production, it would be better for them to go no further. At present the directors had a capital of £87,000, not a penny of which had come from the outside public. He was afraid that in their feverish haste to realise their project they were too anxious to build a city of any kind they could. The proper thing for them to do was to lay before the British public a sound scheme, then instead of going to work with £87,000, they ought to have three or four millions. He agreed with the remark that the Garden City movement was not a new thing. The subject was carefully thought out in the middle of last century, by a celebrated writer of immense experience, James Silk Buckingham. With regard to beet cultivation, he agreed with the Chairman as to the necessity of the sugar industry being put upon a stable foundation by the Legislature. It could not be expected that men would put up sugar factories at a cost of £60,000, unless they were perfectly sure that no change in the revenue arrangements of the country would be suddenly sprung upon them. He hoped that the Government would at once see the desirableness of helping agricultural colleges. What Miss Bradley had said on the subject was entitled to great weight. The fact that ladies were sometimes short of capital was not surprising, but he was afraid that farmers suffered very much from the same malady. He had had a long correspondence with that splendid patriot Sir Horace Plunket, who had inaugurated a co-operative system of dairying in Ireland. Within four or five years the Association, which Sir Horace Plunket inaugurated, had been able to start hundreds of co-operative dairies in Ireland, and the export of butter from Ireland had gone up in a remarkable way. This result had been brought about by the simple means of enabling people to subscribe to small profit-sharing organisations. Miss Bradley needed not to hesitate to turn out as many agricultural pupils as she could. Every one could be

A.—Results of Experimental Beet-Growing, 1902.

Reference No.	Trials made by	Farming at	Nature of Soil.	Nature of Manure Used, and Quantity per Acre.	Length of Time.	Yield of Roots in Tons per Acre.
				ENGLAND.	Days.	
1	The Right Hon. the Earl of Lathom.	Crams Farm, Lathom, Ormskirk, Lancaster.	Strong loam, clay subsoil.	15 tons farmyard manure per acre, Ohlendorf's special beetroot manure, 2 cwt. being expended to the acre.	166	..
2	Liverpool Corporation	Sewage Farm, Walton	Heavy soil, clay subsoil	Sewage	174	18
3	" "	" "	" "	"	174	18
4	" "	" "	" "	"	174	18
5	W. J. C. Moens, J.P.	Tweed Estate, Holmfield, Lymington, Hants.	Sandy loam, sand subsoil, no lime.	20 loads of farmyard manure, 56 lb. sulphate of ammonia, 112 lb. dissolved bones, 224 gypsum, 112 soil.	149	19
6	" "	" "	" "	Ditto.	149	19
7	J. M. Scott	Crookes Farm, Crookes, Newent, Glos.	Soft loam, sand subsoil	30 loads of farmyard manure, 3 cwt. bone-dust, 2 cwt. superphosphate.	183	10
8	Rev. Edward Muckleston, M.A., Haseley Rectory.	The Glebe Farm, Haseley, Warwick.	Sandy soil, sand and gravel subsoil.	Guano from Ohlendorf	146	19
9	John Woolston, J.P., Stamford.	Northfield Farm, Stamford	Medium clay and limestone, mixed subsoil.	Ordinary farmyard manure, put in in the autumn, about 15 loads per acre.	154	18
10	E. C. Allen	Digby Fen Farm, Highfield, Metheringham, Lincs.	Black soil, with clay subsoil.	5 cwt. Albert's basic slag, 2 cwt. superphosphate of lime.	151	18
11	"	" "	" "	Ditto.	151	18
12	The Right Hon. the Earl of Denbigh.	.. ..	.. ..	..	..	..
13	" "	.. ..	.. ..	..	..	..
14	" "	Brockhurst Farm, of Brockhurst, Lutterworth, co. Warwick.	Sandy loam, sandy subsoil.	12 cartloads of farmyard manure, 4 cwt. superphosphate, 1 cwt. sulphate of ammonia.	159	13
15	" "	Pailton Field Farm	Heavy loam, clay subsoil.	3 cwt. superphosphate, 1 cwt. sulphate of ammonia.	183	14
16	" "	High Cross Farm, High Cross, Lutterworth.	" "	10 tons farmyard manure, 3 cwt. superphosphate, 3 cwt. kainit.	182	20
17	" "	Manor House Farm, Manor House, Lutterworth.	Loam	15 loads farmyard manure, 3 cwt. prepared bones, 3 cwt. basic slag, 1½ cwt. kainit, 1 cwt. nitrate soda.	183	17½
18	W. Aldridge, B.A.	The Experimental Plots, Shepton Mallet Grammar School.	Loam overlying lias clay and rocks.	Unmanured	191	17½
19	"	" "	" "	125 lb. nitrate of soda per acre	191	20
20	"	" "	" "	375 lb. superphosphate per acre	191	16½
21	"	" "	" "	250 lb. kainit per acre	191	19½
22	"	" "	" "	125 lb. nitrate soda and 375 lb. superphosphate per acre.	191	18½
23	"	" "	" "	125 lb. nitrate soda, 375 lb. superphosphate, and 250 lb. kainit per acre.	191	19½
24	"	" "	" "	375 lb. superphosphate, 250 lb. kainit per acre	191	21½
25	"	" "	" "	125 lb. nitrate soda and 250 lb. kainit per acre	191	18½
26	"	" "	" "	15 tons compressed sewage slutch	191	17½
27	"	" "	" "	15 tons farmyard manure	191	18½
28	Prof. C. G. Freer-Thonger	The Colonial College, Hollesley Bay, Suffolk.	Medium loam alluvium	16 loads farmyard manure	199	12
29	George Capeling	Wallfield, near Bodelfarm, Brenzett, Kent.	Dark loam, clay subsoil	30 loads farmyard manure, 3 cwt. soda	209	30
30	C. F. Ellis	Minster Lodge, Ormskirk	Black soil	Horse manure	168	..
31	T. Thomas	West Royd Paddock, Formby-on-Sea, Lancs.	Sandy soil	10 tons horse manure, 3 cwt. special artificial compound manure.	168	47
				Average of the 31 Experiments in England	**160**	**16·05**
				SCOTLAND.		
32	West of Scotland Agricultural College.	Holmes Farm, Kilmarnock, Ayr.	Light loam in good condition.	10 tons farmyard manure (in drills), 4 cwt. superphosphate (30 parts), 2 cwt. kainit, 1 cwt. sulphate of ammonia, 1 cwt. nitrate of soda, top dressed.	181	..
33	Alexander Leask	Oldmill of Shivas of Ellon	Stiff sandy soil, clay subsoil.	5 cwt. nitrate of ammonia, 10 cwt. soluble phosphate, 19 cwt. insoluble phosphate, 7 cwt. potash.	198	15
34	Peter Davidson	Strath Farm, Tertowie, Kinaldie, Aberdeenshire.	Black, with clay subsoil	7 tons turnip manure, 15 tons farmyard manure.	177	4½
35	George Cumming	Victoria Cottage, Drumoak, Aberdeenshire.	Black mould	10 tons farmyard manure	149	15
36	George Cooper	Farm of Candy, Glerach Estate of Crathie, Drumoak.	Old black soil	18 loads farmyard manure and 4 cwt. potatoes manure.	172	16·12
37	Robert Murray	Betty Field, County Roxburgh, Charterhouse, Kelso, N.B.	Medium light sandy subsoil.	Equal parts of saltpetre, kainit, and ground-lime, 10 tons farmyard manure.	168	..
38	Alexander Lowe	Cothill Farm, Woodside, Aberdeen.	Medium loam and light clay subsoil.	18 tons farmyard manure per acre and 4 cwt. beet manure.	169	6·16
39	David Pringle	Ednam Farm, Roxburgh, Kelso.	Sandy loam	15 cartloads farmyard manure, 5 cwt. dissolved bones.	150	17
40	William Milne	Haddo House Estate Farm, Milton of Fochel, Old Meldrum.	Black soil, soft red subsoil.	15 tons farmyard manure	191	..
				Average of the 9 Experiments in Scotland	**172**	**12·1**
				IRELAND.		
41	Right Hon. Lord Carew	Castle Boro' Home Farm, Enniscorthy, co. Wexford.	Light clay soil, gravel subsoil.	20 tons farmyard manure per statute acre, 6 cwt. bone manure per acre.	185	16
42	Charles McCoy	Ballyara, Tubbercurry, co. Sligo.	Fair loamy soil, gravel subsoil.	20 cartloads of farmyard manure per statute acre.	150	18
				Average of the 2 Experiments in Ireland	**170**	**17**

B.—Results of Analysis of Beets grown as per Table A.

Reference No.	Previous Crop.	Average Weight of Roots in Grammes.	Quantity of Sugar in 100 Parts of the Juice.	Quantity of Non-Sugar in 100 Parts of the Juice.	Percentage of Purity.	Average Weight in Grammes.	Quantity of Sugar in 100 Parts of the Juice.	Quantity of Non-Sugar in 100 Parts of the Juice.	Percentage of Purity.	Quantity of Sugar in 100 Parts of the Roots.	Average Weight in Grammes.	Quantity of Sugar in 100 Parts of the Juice.	Quantity of Non-Sugar in 100 Parts of the Juice.	Percentage of Purity.	Quantity of Sugar in 100 Parts of the Roots.	Average Weight in Grammes.	Quantity of Sugar in 100 Parts of the Juice.	Quantity of Non-Sugar in 100 Parts of the Juice.	Percentage of Purity.	Quantity of Sugar in 100 Parts of the Roots.
		F. O. Licht, Magdeburg.				Aderstedt.					Vilmorin Blanche.					Schlieckmann.				
1	Oats	496	14·75	2·75	84·29	912	18·60	3·10	85·71	17·90	..	..	..	..	..	..	..	..	..	..
2	Grass	496	14·75	2·75	84·29	1167	17·10	2·70	86·36	16·40	..	..	..	..	..	..	..	..	..	..
3	"	496	14·75	2·75	84·29	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
4	"	496	14·75	2·75	84·29	..	..	..	..	..	1844	17·00	2·00	86·06	17·00	..	..	..	..	..
5	Sugar beet on the same plot for 25 years.	496	14·75	2·75	84·29	..	..	..	..	..	977	18·80	2·10	89·95	18·10	1444	19·30	2·40	88·94	17·90
6	" "	496	14·75	2·75	84·29	806	18·60	2·90	86·63	18·20	..	..	..	..	..	..	..	..	..	..
7	Wheat	496	14·75	2·75	84·29	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
8	Oats	496	14·75	2·75	84·29	..	..	..	..	..	888	16·90	2·20	88·49	16·30	..	..	..	..	..
9	Wheat	496	14·75	2·75	84·29	924	17·60	2·20	88·85	17·00	907	16·70	2·80	89·50	16·90	..	..	..	..	..
10	"	496	14·75	2·75	84·29	867	17·10	2·70	86·36	16·40	..	..	..	..	..	..	..	..	..	..
11	"	496	14·75	2·75	84·29	..	..	..	..	..	..	..	..	..	..	837	17·90	2·90	86·66	17·00
12	..	554	17·50	2·50	87·50	..	..	..	..	..	..	..	..	..	..	788	17·90	2·50	87·74	17·00
						Klein Wanzleben.					Vilmorin Rose.									
13	..	554	17·50	2·50	87·50	801	17·40	2·30	88·33	16·70	..	..	..	..	..	..	..	..	..	..
14	Oats	554	17·50	2·50	87·50	866	17·20	2·40	87·75	16·50	..	..	..	..	..	..	..	..	..	..
15	Wheat	554	17·50	2·50	87·50	944	17·80	2·60	87·25	17·10	..	..	..	..	..	..	..	..	..	..
16	Vetches	554	17·50	2·50	87·50	912	16·60	2·20	88·29	16·00	..	..	..	..	..	..	..	..	..	..
17	Oats	554	17·50	2·50	87·50	785	16·90	2·40	87·56	16·20	..	..	..	..	..	..	..	..	..	..
18	Wheat	496	14·75	2·75	84·29	..	..	..	..	..	771	17·20	2·90	85·57	16·60	..	..	..	..	..
19	"	496	14·75	2·75	84·29	..	..	..	..	..	744	15·80	2·10	88·20	15·30	..	..	..	..	..
20	"	496	14·75	2·75	84·29	..	..	..	..	..	990	17·30	2·30	88·20	16·60	..	..	..	..	..
21	"	496	14·75	2·75	84·29	..	..	..	..	..	826	16·80	2·60	86·54	16·20	..	..	..	..	..
22	"	496	14·75	2·75	84·29	..	..	..	..	..	929	17·20	3·00	85·14	16·40	..	..	..	..	..
23	Wheat	496	14·75	2·75	84·29	..	..	..	..	..	844	16·80	2·00	85·27	16·00	..	..	..	..	..
24	"	496	14·75	2·75	84·29	..	..	..	..	..	826	16·00	2·50	86·48	15·50	..	..	..	..	..
25	"	496	14·75	2·75	84·29	..	..	..	..	..	774	19·20	2·40	88·88	18·40	..	..	..	..	..
26	"	496	14·75	2·75	84·29	..	..	..	..	..	927	18·40	2·20	89·32	17·70	..	..	..	..	..
27	"	496	14·75	2·75	84·29	..	..	..	..	..	931	16·30	2·60	87·24	15·70	..	..	..	..	..
28	"	496	14·75	2·75	84·29	..	..	..	..	..	888	17·10	2·90	85·50	16·30	..	..	..	..	..
						Schreiber.					Breustelt.									
29	Beans	496	14·75	2·75	84·29	1257	16·50	2·20	88·23	15·90	..	..	..	..	..	..	..	..	..	..
30	Potatoes	496	14·75	2·75	84·29	887	18·30	2·60	87·56	17·50	..	..	..	..	..	..	..	..	..	..
31	Sugar beet	496	14·75	2·75	84·29	..	..	..	..	..	1031	16·80	2·60	86·55	16·10	..	..	..	..	..
		..	..	..	..	**901**	**16·88**	**2·46**	**84·53**	**16·19**	..	..	..	..	..	..	..	..	..	..
						Schlieckmann.					Vilmorin Blanche.									
32	Oats	496	14·75	2·75	84·29	991	16·80	2·30	87·95	16·00	..	..	..	..	..	..	..	..	..	..
33	"	496	14·75	2·75	84·29	..	..	..	..	..	592	17·20	2·20	88·65	16·60	..	..	..	..	..
34	"	496	14·75	2·75	84·20	..	..	..	..	..	642	17·80	2·90	85·64	16·80	..	..	..	..	..
35	Corn	496	14·75	2·75	84·29	..	..	..	..	..	799	14·90	2·20	87·18	14·30	..	..	..	..	..
36	Oats	496	14·75	2·75	84·29	..	..	..	..	..	698	17·80	2·30	88·26	16·40	..	..	..	..	..
37	"	496	14·75	2·75	84·29	..	..	..	..	..	788	16·80	2·90	84·89	15·40	..	..	..	..	..
38	"	496	14·75	2·75	84·29	..	..	..	..	..	978	18·00	3·30	84·50	17·10	..	..	..	..	..
39	"	496	14·75	2·75	84·29	..	..	..	..	..	774	15·30	2·50	85·95	14·10	..	..	..	..	..
40	Turnips	496	14·75	2·75	84·29	..	..	..	..	..	986	16·80	2·40	87·50	16·20	..	..	..	..	..
		..	..	..	..	**798**	**16·65**	**2·55**	**86·71**	**15·82**	..	..	..	..	..	..	..	..	..	..
						Vilmorin Rose.					Aderstedt.									
41	Early potatoes	496	14·75	2·75	84·29	955	17·60	2·70	86·69	16·80	..	..	..	..	..	..	..	..	..	..
42	Turnips	496	14·75	2·75	84·29	..	..	..	..	..	817	18·20	2·70	87·08	17·30	..	..	..	..	..
		Average of the 42 Experiments in the United Kingdom in the Year 1902														678	16·80	2·49	85·11	16·15
		Compared with German grown roots according to Mr. F. O. Licht, Magdeburg, in the Year 1902														492	14·79	2·64	82·74	..

C.—Results of Beet Culture upon the Liverpool Sewage Farm.

Year.	Soil.	Manure.	Duration of Growth.	Crop (Tons per Acre).	Weight of Roots in Grammes.	Percentage of Sugar.	Percentage of Non-sugar.	Quotient of Purity.	Seed used.
			Days.						
1898	Clayey	Sewage	153	33	578	18·50	2·10	86·54	Klein, 'Vilmorin.'
	"	"	153	26	846	14·60	2·50	85·38	Aderstedt, 'Original.'
	"	"	153	32	624	16·80	2·40	87·50	Klein, 'Wanzleben.'
	Garden soil	10 tons horse manure	134	34	810	15·00	2·40	86·20	Klein, 'Vilmorin.'
	" "	" "	134	28	784	16·10	2·30	87·50	Aderstedt, 'Original.'
	" "	" "	134	32	410	13·80	2·40	85·17	Klein, 'Wanzleben.'
	Strong land, clay subsoil.	Sewage	206	34	1,070	18·50	2·80	87·04	Klein, 'Vilmorin.'
	" "	"	206	26	835	18·00	3·70	82·95	Aderstedt, 'Original.'
	Light land, sand subsoil.	"	206	28	973	18·50	2·40	88·51	Klein, 'Vilmorin.'
	" "	"	206	34	1,131	19·70	2·90	87·17	Aderstedt, 'Original.'
	Strong, heavy land	10 tons horse manure and sewage.	128	30	390	13·90	2·20	86·33	Janasz, 'Zuckerreiche.'
	" "	" "	128	32	587	14·30	2·30	86·14	Braune, 'Vilmorin.'
	" "	" "	128	24	381	14·30	2·10	87·10	Sutton (English seed).
	" "	" "	168	26	833	15·30	2·60	85·40	Janasz, 'Zuckerreiche.'
	" "	" "	168	29	991	16·50	3·00	84·61	Braune, 'Vilmorin.'
	" "	" "	168	36	749	17·70	2·60	87·19	Sutton (English seed).
	Medium light land	1½ tons horse manure; no sewage.	134	28	369	15·80	2·60	85·80	Janasz, 'Zuckerreiche.'
	" "	" "	184	24	617	14·60	2·70	84·39	Braune, 'Vilmorin.'
	" "	" "	134	26	548	9·80	2·80	77·77	Sutton (English seed).
	" "	" "	184	29	600	16·10	2·40	87·03	Janasz, 'Zuckerreiche.'
	" "	" "	184	26	615	19·00	2·90	86·75	Braune, 'Vilmorin.'
	" "	" "	184	32	587	16·90	2·20	88·48	Sutton (English seed).
	" "	10 tons horse manure; no sewage.	134	28	986	12·00	2·60	82·19	Braune, 'Wanzleben.'
	" "	Sewage	184	36	426	14·20	2·10	87·11	" "
	" "	10 tons horse manure; no sewage.	184	30	745	18·60	2·50	88·15	" "
	" "	Sewage	184	41	972	17·90	2·40	88·17	" "
1900	Medium light sand subsoil.	Ordinary sewage	148	12	913	17·00	2·40	87·63	Brenstedt.
	" "	" "	148	12	888	19·40	2·80	69·40	Aderstedt.
	" "	" "	148	16	746	18·20	2·40	88·35	Schlieckmann.
	" "	" "	148	18	976	17·40	2·50	87·44	Vilmorin, 'Blanche.'
	Dark soil, sandy subsoil.	Sewage during winter months; not treated with sewage when growing.	157	23	867	17·70	2·40	88·06	Brenstedt.
	" "	"	157	15	945	16·40	2·50	86·77	Aderstedt.
	" "	"	170	22	1,042	17·30	2·20	88·72	Schlieckmann.
	" "	"	157	16	795	15·50	2·30	87·07	Vilmorin, 'Blanche.'
1901	Dark soil	Sewage	191	45	963	18·70	2·50	88·20	Vilmorin.
	"	"	191	38	1,147	17·00	2·40	87·63	"
	"	"	191	41	914	18·30	2·60	87·50	Schlieckmann.
	"	"	191	43	900	18·20	2·40	88·35	Braune, 'Elite.'
1902	Heavy soil, clay subsoil.	"	174	18	1,167*	17·10	2·70	86·36	Aderstedt.
	" "	"	174	18	1,344*	17·90	2·90	86·06	Vilmorin, 'Blanche.'
	" "	"	174	18	1,444*	19·30	2·40	88·94	Schlieckmann.

* These are the ones shown in the illustration.

D.—Experiments in Beet Culture, using Sewage as a Manure.

Year.	Farm.	Soil.	Manure.	Duration of Growth.	Crop (Tons per Acre).	Weight of Roots in Grammes.	Percentage of Sugar.	Percentage of Non-sugar.	Quotient of Purity.	Seed used.
				Days.						
1898	Oxford Corporation.	Sandy	Sewage	181	36	1,792	16·00	2·20	88·29	Brenstedt, 'Elite.'
	" "	"	"	181	36	2,941	14·70	2·40	85·95	Klein, 'Wanzleben.'
	" "	"	"	181	34	2,617	15·20	2·60	85·38	Schlieckmann.
	" "	"	"	181	41	2,400	16·40	3·00	84·54	Simon Legrand, 'Blanche.'
	Malvern Council House.	Loam, gravel subsoil.	"	142	34	1,492	14·50	2·60	84·79	Janasz, 'Zuckerreiche.'
	" "	"	"	142	32	1,586	14·50	2·40	85·78	Simon Legrand, 'Blanche.'
	Redding Farm, Upminster, Essex.	Stiff loam	20 loads sewage, 4 cwt. superphosphate of lime, nitrate of soda and kainite.	143	28	618	15·40	2·60	85·55	Vilmorin, 'Blanche.'
	" "	"		143	18	694	13·70	2·70	83·54	Schreiber, 'Klein Wanzleben.'
	Lower Edmonton.	Heavy clay subsoil.	Sewage	184	21	1,545	13·80	2·40	85·18	Schreiber, 'Klein Wanzleben.'
1901	Shepton Mallet	Loamy	Sewage sludge	180	14	946	17·50	2·60	87·06	Vilmorin, 'Blanche.'
1902	" "	"	15 tons compressed sewage sludge.	191	17½	927	18·40	2·20	89·32	" "

placed in a small dairy, and the necessary capital could be forthcoming by means of such a system.

The CHAIRMAN explained that the remarks which he had made with regard to the Garden City scheme were intended more as questions to call forth information than as as an expression of his own views. He had not studied the question with as much care as perhaps he ought to have done, for he had not had the opportunity. He was sure the meeting would pass a hearty vote of thanks to Mr. Sennett for his very valuable paper.

Miscellaneous.

ADMIRALTY CHARTS.

The following is the official list of charts issued by the Hydrographic Department of the Admiralty, in November and December last :—

New Charts.—No. 1698—England, south coast; Dover bay. 1951—England, west coast; Liverpool bay; Prince's dock. 2326—Scotland, west coast; Loch Killisport to Cuan sound, including the sound of Jura. 3377—Norway, west coast; Lofoten islands; Ure to Bretlesnes. 3372—Greece, south coast; Gulf of Lakonikos. 3389—Black sea, sea of Azov; Taganrog gulf. 444—West Indies, Cuba; Cienfuegos bay (port Xagua); entrance to Cienfuegos bay. 3413—South America, north coast; Margarita island; La Mar bay. 3382—Gulf of Mexico; Mississippi river; the passes to New Orleans. 1782—Peru; Pisco bay to St. Elena point. 3393—Alaska; Pribilof islands. 796—Malacca strait; approaches to Malacca; Pyramid shoal to Pulo Besar. 3394—Celebes; Tanjong Lutuno to Dondo point. 3407—Philippine islands; Mindanao, north coast; Murcielagos bay. 3369—Philippine islands; Luzon island to Masbate island, including Tikao island. 3401—Philippine islands; Kalamianes group; Kulion island; Halsey harbour. 3392—Philippine islands; Luzon, west coast; Port Bolinao. 3386—China, east coast; Mirs bay; Long harbour and approaches. 3388—China, north coast; terminal head to Hai Yung Tau, including Elliot and Blonde groups. 2436—Japan; Liukiu islands :—Unten ko. 3395—Japan; plans on the west coast of Nipon :—Futami anchorage. 3374—Japan; Nipon, south coast :—Benten saki to Miwazaki, including Urakami ko and Katsuura wan. 3325—Japan, inland sea; channel between Neko seto and Mitsugi. 3391—Solomon islands; anchorages in Ysabel island :—Karrigole harbour; Vulavu anchorage. 3398—Solomon islands; anchorages in Ysabel island :—Marie lagoon. 3199—Solomon islands; anchorages in Ysabel island :—Kesuo cove; Tunnibuli. 2293—Mexico, south west coast; ports in gulf of California; new plan :—approach to La Plaz harbour; plan added :—La Paz harbour. 3138—Anchorages in south-east Alaska; plan added :—Hassler harbour. 2772—Eastern archipelago; anchorages in Gillola; plan added :—Foja anchorage. 2718—Celebes; anchorages on the east coast; plans added :—Totok bay, Paguyama river entrance, Tomini road, Una una road, Togean anchorage, Luwuk bay, Arjuno bay, Lelomping bay. 976—Philippine islands; Luzon island; new plan :—Port Mariveles. 2975—Japan; anchorages on the west coast of Yezo island; new plan :—Yesashi anchorage.

Charts that have received additions or corrections too large to be conveniently inserted by hand, and in most cases other than those referred to in the Admiralty Notices to Mariners :—

Nos. 954—Ireland, west coast; Achill sound, southern entrance. 2289—Norway; The Skagerrak. 2842*a*—Baltic sea. 2331—Baltic sea; Gulf of Finland :—Haugö head to Barö sound. 173—Baltic sea; Gulf of Finland; approaches to Helsingfors and Sveaborg. 2224—Baltic sea; Gulf of Finland; Helsingfors, Sveaborg, and parts adjacent. 2364—Germany, north coast; Lübeck bay and Femern belt. 2863—East coast of United States; Cape Fear river. 2677—West Indies; Leeward islands; Culebra or Passage island. 2452—West Indies; Leeward islands; Virgin islands, sheet III. 2002—South America, east coast; Rio Grande do Sul. 3271—British Columbia; Alert bay. 2448—British Columbia; approaches to Fitz Hugh and Smith sounds. 2463—Alaska; Port McArthur to Windham bay. 2462—Alaska; Windham bay to Icy cape. 608—Africa, west coast; River Gambia entrance. 149—Africa, west coast; Old Calabar river. 671—Africa; plans on the east coast. 2760—Sumatra, west coast; sheet I., Ached head to Tyingkok bay. 709—Sumatra, west coast; Ujong Masang to Ujong Indrapura. 1696—Eastern Archipelago; Lombok to Flores. 2195—Celebes; sketch plans of anchorages. 2914—Philippine islands; Palawan island; Port Princesa. 976—Philippine islands; Manila bay. 2562—China, south coast; Canton river with its western branches to Samshui. 2409—China; west coast of Formosa. 2357—China, north coast; Ching Wang tao road. 3033—South Pacific ocean; New Hebrides islands and New Caledonia.

These charts are issued by Mr. J. D. Potter, 145, Minories.

Correspondence.

THE REPRESSION OF THE BRITISH INVENTOR.

I would respectfully and urgently request your careful consideration of the enclosed remarks on "The Repression of the British Inventor," for most certainly such is the effect of your Patent-laws.

Mr. Mosely has spent considerable sums to demonstrate to the British workmen how far he is behind in the mechanic arts, and much criticism uncomplimentary to British intellect has resulted.

There are no better intellects, but they require incentive to bring them into action, and a reasonable hope of reaching the goal to keep them moving. I made my first invention while a British subject so know whereof I speak. If a workman in a British factory makes some improvement in its methods, the employer, if he is enterprising, takes out a patent for it (anyone can do so) and if he is "generous" increases the workman's wages a few shillings.

This appropriation of an invention cannot occur under United States laws, as the applicant must state under oath that to the best of his knowledge "he is the sole and original inventor," and even if the inventor has made the machine in his employer's time and with his employer's tools and materials, all the employer can claim is a shop-right. If he wishes the entire rights he must negotiate with the inventor.

Shortly after arriving in this country, I conceived another invention. My employers were still the same people and offered to take out the patent, but found they could not without committing perjury. They then gave me the alternative of assigning the invention to them or giving up my position. I chose the latter, although a stranger in this country and in debt for my machine. The case looked rather hopeless, but inside a month I cleared more than my year's salary. A manufacturer examined my machine and patent, gave me his manufacturing cost (cost to me), and paid me the difference between that and the selling price.

Very few inventors are technical men or able to make working drawings, and their first machines are usually very crude. This entails considerable expense for re-designing, patterns, dies, &c., before machines can be turned out, and an English manufacturer would hardly be warranted in risking this outlay on a home patent.

The new law making an examination of English patents for fifty years back is a small move in the right direction, but as they only cover a fraction of the development of the arts, it is labour thrown away.

It must be clear to the Society of Arts that Great Britain is not holding its prestige in the world of mechanics. Also that the cause is not from lack of ability or ingenuity in her people. If this required demonstration, aside from the names of the famous inventors of the past, it would be proven by the fact that the list still shows (excepting a small percentage) the inventors of this country to be either British born or of British origin.

The Society of Arts can have no greater duty than to discover the cause and remedy for this torpitude in Great Britain and her colonies, for it exists wherever her flag flies. You cannot expect continued effort unless there is some encouragement, incentive, or a reasonable hope of accomplishment.

There is neither encouragement, hope, nor incentive for the inventor under your Patent-laws. Your patents convey no sense of ownership nor evidence of the applicants having invented anything. It is simply a certificate of registration of the application, drawings, and claims, and that they conform to the requirements of the office.

To give a patent any tangible or marketable value, it must first be fought through the courts to a decision in its favour—even if the inventor's means should permit him to do so, and he should live to see the end of the litigation, the term of his patent would probably have expired, or been materially reduced—and if he is defeated in even one claim, though he has fifty others that are good, his whole patent is declared invalid.

The English investor asks first, "have you a United States or German patent ?" Unless you have one or both of these the English patent carries no weight and his interest ceases.

Is it justice to your inventors that they must seek from a foreign country protection in their own—these foreign patents are practically a guarantee that "you are the sole and original inventor of a new and novel device;" those who wish to invest feel safe, and those who infringe do so at their peril.

Your Government has not even the excuse of "expense," for although the United States Patent Office fees are only forty dollars (£8) the office is now over two million dollars ahead of its outlay. It would not cost Great Britain anything to protect her inventors—but instead of doing so she and her colonies prey upon them. The inventor is made a source of revenue, to cover the simplest device with patents "under the Flag," and pay the taxes costs over a thousand pounds. This is how Great Britain encourages the mechanics' arts.

History shows no more heroic struggles than the early lives of the great inventors, for in the beginning all inventors are poor—their first "ideas" are begotten in necessity, carried on under privations, sacrifices, and repeated disappointments—to be received at first with jeers and opposition; the experienced mechanic flouts him, and the capitalist, finding him reduced to a crust, offers him a "song;" and when he looks to the Government, he faces "the law," "he asks for bread and ye give him a stone."

You loudly proclaim "that a nation's greatest assets are in the brains of its people" and think you have done your duty; then you tax those "assets" till they shrink into nothingness; you make it easy for the employer to steal the "assets" of the inventor; and having made it hopelessly impossible for the inventor to protect his own assets, "he buries his talents in the ground."

Instead of fostering invention and progress in the mechanics' arts, you smother it, and the Prince of Wales may well cry, "England Awake!"

GEORGE ARCHIBALD LOWRY.

List showing the various British colonies, and the cost of a patent for each colony, including India, Canada, and England, as follows:—

	Dols.
England	75·00
Canada	75·00
India	175·00
New South Wales	90·00
New Zealand	80·00
Queensland	80·00
South Australia	85·00
Victoria	80·00
West Australia	90·00
Bahama Islands	225·00
Barbadoes	175·00
British Guiana	350 00
British Honduras	250·00
Ceylon	250·00
Fiji Islands	300·00
Jamaica	200 00
Leeward Islands	375·00
Natal	200·00
South African Republic	275·00
Tasmania	100·00
Straits Settlements	225·00
Cape Colony	150·00
Total	$3,830·00
	£766

Data showing the total amount of taxes during the life of patents in the various countries named. These amounts do not include the initial or filing Government fees in any of the countries, but merely the total amount required to be paid should the patents be maintained throughout the entire length of their term.

England	95 pounds	95
Canada	$40·00	8
India	750 Rps.	75
New South Wales	None.	
New Zealand	15 pounds	15
Queensland	15 ,,	5
South Australia	5 ,,	5
Victoria	5 ,,	5
Western Australia	8 ,,	8
Bahama Islands	20 ,,	20
Barbadoes	30 ,,	30
British Guiana	$100·00	20
British Honduras	$155·00	31
Ceylon	750 pounds	Rps.
Fiji Islands	None	75
Jamaica	None.	
Leeward Islands	30 pounds	30
Natal	15 ,,	15
South African Republic	60 ,,	60
Tasmania	35 ,,	35
Straits Settlement	None.	
Cape Colony	30 pounds	30
		£562

THERMIT.

I desire to add a few words to what I said last Wednesday at the Society of Arts, especially as I had not an opportunity of revising it.

In electric coal-cutters (of which many are in use), I believe the English engineers are in advance of the Germans.

Efforts are now being made which I am certain will result in our reconquering the electrical power industry, as we are now reconquering the motor car industry (which ought to have been ours from the beginning).

Personally, I have every belief in our own engineers; and I only wish I had not been obliged to admit that in electrical coal mining the Germans had not stolen a march upon them.

H. CUNYNGHAME.

February 15th, 1904.

General Notes.

HORTICULTURAL EXHIBITION.—A Grand Horticultural and Gardening Exhibition will take place in the month of June next, under the auspices of the Royal Botanic Society. It is intended that the Exhibition shall be held in the New Exhibition Grounds of the Society in Regent's-park. The proposed scheme embraces Horticulture, Forestry, Botany, Educational Methods, Nature Study, and a special section for Colonial produce. In addition to the Exhibition, Lectures, Conferences, and Conversazione are in course of arrangement.

EXHIBITION OF PEWTER PLATE.—An Exhibition of many interesting specimens of old Pewter Plate, both English and Foreign, will be held in Clifford's Inn Hall, Fleet-street, E.C., from February 24th to March 26th. The Exhibition will be open on weekdays from 10.0 a.m. to 5.30 p.m., except upon March 17th, when it will be closed at 4.30 p.m. Four Lectures on the History, the Manufacture, the Decoration of the metal, the Pewterers' Marks and Touches, will be given by Mr. H. J.L. J. Massé on March 2nd, 9th, 16th, and 23rd, at 8.30 p.m., illustrated by the examples in the Exhibition.

PUBLISHERS' EXHIBITION.—A Publishers' Exhibition will be held at the Connaught Drill Hall, Portsmouth, in connection with the Portsmouth Conference of the National Union of Teachers. The 1904 Exhibition will be held on Easter Monday, Tuesday, Wednesday, and Thursday, April 4th to 7th next.

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday Evenings, at 8 o'clock :—

February 24.—"Mahogany and other Fancy Woods available for Constructive and Decorative Purposes." By Frank Tiffany.

March 2.—"Physical Degeneration." By Robert Jones, M.D., B.Sc., F.R.C.S. Sir William Church, Bart., M.D., P.R.C.P., will preside.

March 9.—"Mechanical Piano Players." By J. W. Coward.

March 16.—"Artificial and other Building Stones." By L. P. Ford.

Indian Section.

Thursday Afternoons, at 4.30 o'clock :—

March 10.—"China Grass: its Past, Present, and Future." By Frank Birdwood, B.A. Prof. Sir William Ramsay, LL.D., F.R.S., will preside.

Colonial Section.

Tuesday afternoons, at 4.30 o'clock :—

March 1.—"Nigeria." By Lady Lugard (Miss Flora L. Shaw). The Duke of Marlborough, K.G., Under-Secretary of State for the Colonies, will preside.

Applied Art Section.

Tuesdays, at 4.30 or 8 o'clock :—

March 15, 4.30 p.m.—"Recent Developments in Devonshire Lace-making." By Alan S. Cole, C.B.

Cantor Lectures.

Monday evenings, at 8 o'clock :—

Charles T. Jacobi, "Modern Book Printng." Two Lectures.

Lecture I.—February 22.—*Printing Types.*—Some account of those used by the early and subsequent Printers—Founts specially designed for the private Presses of the present day — Some good Types that may be obtained in the open Market, well adapted for the different classes of Book Printing.

Lecture II.—February 29.—The choice of a suitable Type—The Details of Composition—The Formation of the Page—Margins—Paper—Ink—Presswork—Title Pages—Some conclusions.

Bertram Blount, F.I.C., "Recent Advances in Electro-Chemistry." Three Lectures. March 7, 14, 21.

The following course will be delivered on Monday afternoons, at 4.30 o'clock :—

Prof. R. Langton Douglas, M.A,, "The Majolica and Glazed Earthenware of Tuscany." Three Lectures.

April 25, May 2, 9.

MEETINGS FOR THE ENSUING WEEK

Monday, Feb. 22...SOCIETY OF ARTS, John-street Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr Charles T. Jacobi, "Modern Book Printing." (Lecture I.)

Asiatic, 22, Albemarle-street, W., 3 p.m.

Chemical Industry (London Section), Burlington house, W., 8 p.m. Mr. Thomas T. Tyrer, "Dut Free Alcohol."

Surveyors, 12, Great George-street, S.W., 8 p.m Mr. H. J. Elwes, "British Timber and its Uses."

Geographical, University of London, Burlington gardens, W., 8½ p.m. 1. Captain B. A. Cuning ham, "A Pioneer Expedition to Angola." 2 Major Powell Cotton, "A Journey to Norther Uganda."

Camera Club, Charing-cross-road, W.C , 8½ p.m Prof. Henry Louis, "The World's most Northerl Railway."

Medical, 11, Chandos-street, W., 8½ p.m.

Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p.m Mr. C. W. Odling, "Observations in the Irrigatio of India."

Tuesday, Feb. 23...Royal Institution, Albemarle-street, W 5 p.m. Mr. Ernest Foxwell, "Japanese Life an Character." (Lecture I.)

Hellenic Studies, Burlington-house, W., 5 p.m.

Medical and Chirurgical, 20, Hanover-sq., W., 8½ p.m

Civil Engineers, 25, Great George-street, S.W 8 p.m. 1. Mr. James Denis Twinberrow, "Th Construction of Railway-Wagons in Steel." 2 Mr. Arthur Lewis Shackleford, "The Constructio of Iron and Steel Railway-Wagons" 3. M James Thomas Jepson, "Iron and Steel Railway Wagons of High Capacity."

Photographic, 66, Russell-square, W.C., 8 p.m Mr. T. E. Freshwater, "The History and Lightin of the Magic Lantern."

Anthropological, 3, Hanover-square, W., 8½ p.m.

Wednesday, Feb. 24...SOCIETY OF ARTS, John-stree Adelphi, W.C., 8 p.m. Mr. Frank Tiffan "Mahogany and other Fancy Woods availab for Constructive and Decorative Purposes."

Geological, Burlington-house, W., 8 p.m.

Royal Society of Literature, 20, Hanover-square, W 8½ p.m.

British Astronomical, Sion College, Victori embankment, E.C., 5 p.m.

Thursday, Feb. 25...Royal, Burlington-house, W., 4½ p.m

Antiquaries, Burlington-house, W., 8½ p.m.

Royal Institution, Albemarle-street, W., 5 p.r Prof. H. L. Callendar, "Electrical Methods Measuring Temperatures." (Lecture I.)

Electrical Engineers, 25, Great George-street, S.W 8 p.m. Discussion on Dr. R. N. Walmsle paper, "Trans-Atlantic Engineering Schools ar Engineering."

Camera Club, Charing-cross-road, W.C., 8½ p.r Messrs. Percy Wright and H. Carpenter, "O Square Mile of Holland."

Friday, Feb 26...Royal Institution, Albemarle-street, W 9 p.m. Mr. Alexander Siemens, "New Develo ments in Electric Railway."

Civil Engineers, 25, Great George-street, S.W 8 p.m. (Students' Meeting.) Mr. L. G. Crawfor "Boiler-House Design."

North-East Coast Institute of Engineers and Shi builders, Newcastle-on-Tyne, 7½ p.m.

Clinical, 20, Hanover-square, W., 8½ p m.

Physical, Royal College of Science, South Ke sington, S.W., 5 p.m.

Saturday, Feb. 27...Royal Institution, Albemarle-street, W 3 p.m. Lord Rayleigh, "The Life and Work Stokes." (Lecture II.)

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FRIDAY, FEBRUARY 26, 1904.

'll communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

NEXT WEEK.

Monday, February 29, 8 p.m. (Cantor ,ecture.) Charles T. Jacobi, "Modern ;ook Printing." (Lecture II.)

Tuesday, March 1, 4.30 p.m. (Colonial ection.) Lady Lugard (Miss Flora L. haw), "Nigeria."

Wednesday, March 2, 8 p.m. (Ordi-ary Meeting.) Robert Jones, M.D., B.Sc., '.R.C.S., "Physical Degeneration."

Further details of the Society's meetings ill be found at the end of this number.

CANTOR LECTURES.

On Monday evening, 22nd inst., Mr. harles T. Jacobi delivered the first lecture f his course on "Modern Book Printing."

The lectures will be published in the *ournal* during the summer recess.

APPLIED ART SECTION.

The visit of the members of the Society of rts to the new offices of *The Graphic* in allis-street, Victoria-embankment, on the ıvitation of the proprietors of *The Graphic*, nd kindly arranged by Mr. Carmichael homas, Treasurer of the Society, took place ı Thursday evening, 18th inst.

The offices, situated close to the Victoria-mbankment, were opened in the afternoon ' the same day by their Royal Highnesses the Prince and Princess of Wales. The Tallis-street frontage, of about 100 feet, is opposite to the Guildhall School of Music, and the building has besides frontages of 50 feet each in John Carpenter-street and Carmelite-street, which are on either side of it. Each of the six floors has an area of 5,000 square feet, and there is accommodation for 800 work-people.

The visitors began the tour of the extensive buildings with the Composing-room, where they inspected the methods of type-setting. Thence they went to the Foundry, and here a page plate of type and illustration was taken through the various processes applied to it. Plates were in turn cast, moulded, finished, and nickelled. After seeing the whole method of preparing a plate for the machines, the party descended to the Machine-room in the basement, where the plates are printed for publication. On the way they visited the Folding and Stitching-rooms.

The whole of the machinery is worked by electric power, and each machine is driven by its individual electric motor.

The rooms of the staff of engravers, who are employed in restoring to the printing blocks the tones and artistic feeling of the original drawings, were also visited.

The new buildings are very extensive, and there is a staircase at each end of the building, so that every facility for ingress and egress are obtained. The arrangements for the continuous circulation of the large party were complete.

Each visitor was presented with a book of illustrations of the various departments, and an envelope containing a papier maché mould of an original plate, a stereo taken from the mould, and an impression from the stereo, to illustrate the method of reproduction adopted in *The Graphic* foundry.

COVERS FOR JOURNAL.

For the convenience of members wishing to bind their volumes of the *Journal*, cloth covers will be supplied, post free, for 1s. 6d. each, on application to the Secretary.

LIST OF MEMBERS.

The new edition of the List of Members of the Society is now ready, and can be obtained by members on application to the Secretary.

Proceedings of the Society.

ELEVENTH ORDINARY MEETING.

Wednesday, February 24, 1904; SIR HENRY TRUEMAN WOOD, M.A., Secretary of the Society, in the chair.

The following candidates were proposed for election as members of the Society:—

Armstrong, Miss C. M., 31, Hereford-square, S.W.
Bonny, Harry, Stafford-house, Church-end, Finchley.
Burbidge, Richard, 21, Hans-mansions, S.W.
Clark, Edward James, Hart Accumulator Company, Limited, Marshgate-lane, Stratford, E.
Clough, George Benson, Bracken-knoll, Oxshott, Surrey.
Darley, Cecil West, I.S.O., M.Inst.C.E., 34, Campden-hill-court, Kensington, W.
Deiró, Sebastiao Clementino, O.I.C.V.V., Vice-Consul for Brazil, 20, Quay-street, Manchester.
Keys, Robert Peake, Wharncliffe, 237, Devonshire-road, Honor Oak-park, S.E.
Sutton, Leopold Arthur, 36, Chancery-lane, W.C.

The following candidates were balloted for and duly elected members of the Society:—

Bell, William, Hill Crest, Walmer, Kent, and Junior Constitutional Club, S.W.
Dean, Frederic William Charles, M.I.Mech.E., Royal Arsenal, Woolwich.
Delmé-Radcliffe, Lieut.-Col. Charles, British Commissioner, Anglo-German Boundary Commission, Uganda, East Africa.
Dennis, Henry Herd, Cognac, Charente, France.
Pennington, R. W. R., Carbonic, Mazagon, Bombay, India.
Rudorf, George, Ph.D., B.Sc., 26, Weston-park, Crouch-end, N.
Schweich, Emile, F.C.S., 20, Hyde-park-square, W.
Stanley, E. A., The Electric Railway and Tramway Carriage Works, Limited, Preston, Lancs.
Taylor, R. N., 17, Canonbury-square, N.
Thompson, Edgar W., A.M.I.Mech.E., Boyd's Ice Factory, near Ballard Pier, Bombay, India.

The paper read was—

MAHOGANY AND OTHER FANCY WOODS AVAILABLE FOR CONSTRUCTIVE AND DECORATIVE PURPOSES.

By FRANK TIFFANY.

Whilst accepting the great honour of the invitation of your Council to read a paper on the above, a privilege highly appreciated, still one cannot but feel that the time allowed makes it impossible to deal fully with, and do justice to, the subject. The importance of timber in our commercial economy is well recognised by your Society, seeing that you have devoted several evenings to the consideration of various phases of timber and timber supplies.

We are now said to be living in an iron age, and whilst it is true that metal enters more largely than formerly into our constructive and general economy, it is also an undoubted fact that our modern requirements of timber are depleting the world's forests far in excess of natural reproduction; nor is it appreciated that whilst timber is exhaustible, it is restorable; but, as yet, practically nothing is being done to conserve or reproduce what is, to man, as vital as even "food supplies."

The cynic may say, "Let futurity take care of itself; it has done nothing for me." Granting the truth of the cynicism, is it not also true that we inherited a world most bounteously timbered? Shall we not then do something to hand on to future generations that heritage unimpaired? There is no need for panic, but there is need for prompt action, and if we are to maintain our industrial supremacy something must be done to inaugurate an extensive and scientific system of the re-afforestation of the United Kingdom and Ireland with such timbers as experts may agree upon as being likely to thrive.

We hear much of the open-air treatment of consumption, and see a vast number of the unemployed in our large cities, and there is far too much cant about the liberty of the subject, but it would be a kindness to compel the inefficients to return to the land, and find them employment in forestry.

It would be a folly to delay action until a timber famine is upon us, as merchantable timber cannot be grown in a season, like so much grain or cotton.

Literature, bearing upon timber available for commerce, is meagre, much of what there is, is either too academical, or it is written by some party interested in pushing some unknown and untried wood, with a view of proving that in it users would find a material that in itself excels all other tried and proved timbers.

Such writing betrays much ignorance, it cannot be too distinctly understood that each wood has its own economy. Our object must, therefore, be to learn the special characteristics of those which enterprise and modern transportation have placed at our disposal, and whilst, however, imperfectly enumerating the purposes for which each is peculiarly adapted, it is essential not to hold a brief for any, only

o far as they fulfil such requirements, which ommon experience demands of a wood if it ; to be recognised as being suitable for high lass work. There is a beautiful avenue of ees at Bushey-park, but it does not follow iat they would yield good timber.

Mr. Stone recently read before you a paper n the identification of woods*, so that it is nnecessary to spend much time on that point; may, however, be permissible to state, that to lentify different woods, it is necessary to have knowledge of the definite invariable differnces of their structure, besides that of the ften variable differences in their appearance. 'he craftsman who handles different woods ituitively recognises them, yet notwithstandig this familiarity, he is frequently unable to tate the points of distinction, nor can even n expert determine the identity of what is to im a strange wood.

The needs of general building are in the iain well provided for with soft woods, but ur purview is that of something beyond a iere granary, so that it is necessary to conider the varied requirements of the architect, ngineer, and naval constructor; also the railay carriage and coach builder, the needs of ie cabinet-maker and shopfitter, followed by iose of the silversmith and cutler. The iakers of fancy knick-knacks can utilise many eautifully fine woods, which on account of ieir small sizes are not adapted for large onstructive purposes.

To draw a strict line betwixt what is construcve and what is decorative might be arbitrary, ius the companion way of a modern steamer iay be fitted with the finest fancy woods, and hilst the work is primarily constructive, it ecomes essentially decorative.

In furniture, domestic or otherwise, apart om the utility of the article required, the lea is to embellish, in other words to make it ecorative, hence the demand for high-class ancy woods.

When considering what particular wood to se in any prospective undertaking, if the esult is to be satisfactory—the choice demands iuch thought,

To judge from many years of observation, it s extremely doubtful if wood, as an aid to contructive and decorative art, is appraised at s proper value in first-class buildings. Too equently architects embody in their original esigns some charming features of woodwork, nly to find when the tenders are submitted, iat the gross cost of the entire building is beyond the ideas of the principal or building committee.

Then commences the paring down, which usually results in the exclusion of high-class woodwork; this can only be compared to a lady ordering a silk gown, and accepting it with cotton trimmings. In the North, there is at the present moment a Roman Catholic Cathedral being erected, where the woodwork is of very ordinary soft wood, not in harmony with the richness of the stonework. With reference to the proposed Liverpool Cathedral, it is to be hoped that the architect and building committee will avoid the repetition of such a blunder as the cutting down of wood at the expense of stone. Surely the wealth of Liverpool should provide sufficient money to ensure that every piece of wood shall be oak or teak, either of which if properly selected and manipulated is almost imperishable, and certainly more durable than stone. The glory of our old cathedrals consists largely in their fine woodwork, and there should be no insuperable difficulty in procuring for the new cathedral woodwork that will be for the admiration of all who pass through this gate of the sea—East and West.

With further reference to the "choice of woods," what can be more incongruous than a mahogany pulpit in a Gothic building, or to see drawing-room furniture made of oak? Certain woods are unsuitable for Chippendale or Sheraton furniture; for these styles, Spanish mahogany is decidedly most suitable. Obviously it would be impossible to classify all woods and define their adaptability for each specific style and purpose, but possibly the suggestions named will ensure some little attention.

Apart from style, there is also the question of the utility of a given wood for a specific purpose; thus, in the introduction of fine woods into the fittings and furniture of public buildings, offices, hotels, and steamers, where hard wear has to be withstood, the architect should seek to procure such woods as will not readily indent or absorb the dirt and smoke incidental to the places named. To avoid these objections, it is necessary to choose woods containing most of the essential features which give fancy woods their value.

Briefly summarised, the salient features of what is required of any fancy wood is that it shall possess more or less of the following attributes:—Hardness of surface, but it must not be of such hardness as to render it potty, or brittle, so as to be too difficult to tool; evenness of texture, that is an absence of undue

* *Journal*, vol. l., p. 48.

variation of alternate layers; cohesion of fibre, along with an absence of resinous galls. It is also necessary that the wood should season more or less readily, without a tendency to tear itself into shreds, or to twist and warp when seasoned; nor should it swell and shrink with every slight variation of atmospheric conditions. Colour and figure are points which allow a considerable latitude of choice; it is however, desirable, in high-class woods, that their colour should improve with age; it militates against value when they fade, go black, or become lifeless.

In cabinet-making, glue plays an important part; any wood which will not take glue is worthless for this class of work. It is also essential that a fancy wood should be capable of yielding a fine surface when polished; a wood which unduly absorbs polish is discounted. Many woods which possess the attributes named lack size; but those which have the essentials, combined with length and width, are invaluable in constructive and decorative art.

An important point for the architect, before stipulating for any particular wood, is to learn if its specification will yield the sizes required; an iron girder can be made to any size, but the length and depth of an oak beam is limited to what the tree will yield.

Having thus enumerated the features of the wood in general, it is now desirable specifically to name those woods which are on the market, and in doing this, to give, as far as possible, the peculiar characteristics of each. Perhaps it will simplify the classification to ignore all botanical distinctions and genera; merely giving their well recognised commercial names.

Recognising the fact that each wood has it own special utility, and that no one wood is for every purpose an absolute premier; there are three distinct woods, namely, mahogany, oak, and teak, each possessing many important characteristics so as to justify the expenditure of labour in their manipulation, and rank them as leading fancy woods.

Mahogany, if placed first, must not take that place to the disparagement of either oak or teak. The commanding position of mahogany is not due to any mere freak of fashion, but to its own intrinsic merits, along with the abundance of supply. Thirty feet is not an unusual length, and the squares range from 12 to 50 inches.

Mahogany seasons readily, with an absence of splitting and checking. Much of it is firm grown wood, not too difficult to tool. It stands when wrought, and is practically non-infla mable; it is capable of a high finish in polis ing, and, as a groundwork for paint, it without an equal. Broadly it can, with adva tage, be used for almost every purpose of hi constructive and decorative work.

The range of sizes and quality, the vari of colour, and the diversity of figure (or absen of figure if so required) is, indeed, marvello Whilst special logs fetch high prices, t average value does not exceed that of wan pine, hence the range of purposes to which can be applied.

Mahogany is defective in colour when paleness approaches that of birch, or it may too highly coloured; it is considered go when betwixt the two extremes, that is to sa of a bright ruby appearance.

Grain or texture.—Wood of good quali when firmly grown, should be fine and fr in the working, without being too hard.

Figure.—A log handsomely figured, if good colour and texture, commands in pri shillings as against pence for ordinary woo the selection for figure affords consideral scope for the judgment of buyers. T different figures are technically known "roe," "mottle," "cross mottle," "dapple "fiddleback," and "plum pattern," alo with "curls," but the latter are not much soug by English buyers.

In the main, botanically, our mahogany su plies are the same, but there is a great ran of quality, especially in the African shipmen

As to the classification of the various i ports, it would be misleading to say that o district yields all good and other districts bad; but, speaking generally, the imports Spanish mahogany, that is, St. Domingo a Cuba wood, possess the finest texture, a have, in a marked degree, those chemical co stituents which cause the wood to mellow a improve in colour with age, giving them charm which is distinctively their own.

The supply from St. Domingo is now insi nificant, and consists chiefly of small cha wood. The Cuban shipments, notwithstandi a great quantity of small wood, afford a go range of sizes which fit them for the high purposes of constructive and decorative a The wood is of firm, silky texture, without bei too hard, and when wrought, there is no te dency to warp. Much of it is only sligh figured; when richly figured, it comman high prices. It would be difficult to give ru to enable the layman to distinguish Span mahogany from other varieties, but its sil

texture, with small white specks in the bait (whilst the specks in bay wood are usually black), are useful as guides. Another feature of Spanish wood is its intense coldness of touch compared with bay wood.

The next mahogany in order of merit, is Honduras bay wood, especially the shipments from Belize and Trujillo. These come in larger sizes than Spanish wood, hence their greater adaptability for larger work. Their silky texture, along with a general freedom from serious heart shakes, causes the wood to be much appreciated. In point of size, Honduras wood is excelled by the Tabasco shipments, the latter also yields fine textured, good coloured wood, but the heart shakes are usually more serious. Mexican shipments are much softer, and frequently contain corky heart wood, but the supplies to this country are practically nil.

Nicaraguan mahogany, chiefly shipped in the round, is of mild texture, but the supply is insignificant, and is controlled by a Boston syndicate. Panama mahogany, whilst it is of good texture, is subject to worms, and it comes in such a shockingly battered condition, that it only realises low prices, and the shipments are too erratic to give it a place. From Guatemala there is a nice quality of mahogany shipped, but the heart shakes are serious.

The Costa Rican and Colombian shipments are so variable in quality, and the shipments too uncertain to enable them to be ranked as standard imports.

Unfortunately, whatever may be the merits of the mahogany shipped from the Central American ports the quantities arriving in this country are diminishing. But this is compensated by the development—especially into Liverpool—of the African mahogany business. Although the character of this wood varies, it embraces timber which contains, in a marked degree, those characteristics which make for value. The quantity received is simply enormous, representing the product of different districts; the wood of each has its own utility, but probably the following classification will meet the approval of experts :—

Lagos wood, in colour and silkiness of texture, more closely approximates to the Tabasco shipments, but in size it is generally small.

Benin wood affords an excellent range of sizes, and the logs are well squared. The wood, having a splendid texture, commands a leading position.

Axim and Assinee wood is usually well squared, and yields enormous sizes, the colour is generally good, but the texture is softer than other shipments; it is also found that the logs are more or less liable to cross fractures, which cannot be seen until the logs are cut into. Bathurstwood represents the hardest mahogany from Africa, but the sizes are somewhat small.

There are other African ports from which good merchantable timber is shipped, which, however, does not require any special notice, but Gaboon wood is very little better than birch in colour and texture, and, as a furniture-wood, it should be avoided.

Sapeli wood comes in fine, large, well-squared logs, but is scented like cedar, the colour and texture being extremely variable; it is certainly not growing in favour with buyers, some of whom doubt if the wood is in reality a mahogany.

There can be no doubt that African mahogany is a most desirable addition to our stock of furniture-woods, and if properly selected will hold its own, and the mere fact that figured logs sell at prices ranging from 5s. to 12s. 6d. per foot of inch, is sufficient to show how highly it is appreciated.

Passing to Asiatic mahogany, it lacks the brightness of colour which is usual in other varieties. Of Australian mahogany, occasionally small sample shipments are made; whilst the wood is deeply coloured, it is very dense, and has a tendency to split in seasoning. It is doubtful even if nursed under a preferential tariff, that buyers would take kindly to it so long as they can obtain supplies from the true mahogany belt.

Oak is the king of hard woods grown in the temperate zone. The different varieties are so diversified in colour, density and size, that it would be impossible within the limits of this paper to bring out all the attributes of a wood which enters so largely into heavy constructive work such as bridges, roofs, and the underparts of rolling stock, all of which are subject to strains and stresses requiring a tensile strength and a flexibility, not equalled by any wood known, even if its specific gravity is 40 or 50 per cent. greater.

For church and other interior fittings, or for furniture, whether required for hard wear or for the highest decorative art, oak stands unrivalled; but the variety must be considered in relation to the purpose for which it is intended.

For fine work with intricate details, possibly the best available is the Austrian wainscot, which, owing to its large mild growth, seasons

without unduly checking and splitting; its evenness of colour renders it invaluable.

Crown logs are imported in billet form, clear of heart, and should have deep sides and a narrow sole, otherwise they yield too much wood, narrow and without figure.

Wainscot oak from Lebau and Odessa is of smaller growth and of a more dense nature, hence more apt to split and check, nor can it be produced as clear of heart, as is not only desirable but necessary; it should be avoided in first-class work.

The American equivalent term for "wainscot" is "quartered," and by this system of conversion, all the boards or planks show the figure on the face; the wood is shipped square edged, one edge with the sap on; the range of width varies from three to 18 inches, but anything above 8½ inches average is special. There are so many dealers here in cheap lines, that unless one knows the source of supply, there is no guarantee as to evenness of colour, but the right stock is obtainable from reputable importers, the uniformity of colour and the excellence of quality of the best imports from the States cannot be surpassed by European wood. Taking now the heavy oak trade, let us for a short time return to European shipments.

From Odessa, Dantzig and Stettin, are received partially squared butts and logs 6 to 30 feet long, 12-22 inches deep; these yield good tough wood, some clean and much that is rough, yet it is useful for heavy constructive work not requiring elaborate manipulation.

Formerly, fine handsome well squared logs were shipped from Quebec. The States now send hewn logs, which are useful for general work and waggon building; but the Southern States oak has a great tendency to check, and should not be employed in work requiring a high finish.

There is also an enormous trade done in scantling planks and board, some good, and much indifferent; but the capacity of our general market is great. There is what is known as Red Oak, a porous wood, extremely useful for many purposes; and it is surprising that it is not more appreciated in this country.

In naming English Oak, the last, it is not because its merits are the least; from a patriotic view it occupies a very high position, and it yet remains to be proven whether the costly armour-clad vessels will do the country better service than the ships of oak. English oak, by its density and toughness, is especially applicable to work requiring strength; for vehicular construction it is second to none, b neither the quantities nor the sizes availab would touch the fringe of our necessities. seasoning, especially thick stuff, it is apt check and warp, and at the best it is a tedio process.

Whether English brown oak is a variety, freak, or the result of old age, time will n permit of consideration, but for absolu beauty there is no wood with which to compa it. Its knotty gnarled grain causes an endle variety of shade and colour, but to bring out t best results, all flat work should be used in t veneer. The present price of labour mak such work costly, but the result would better.

Teak.—Had this wood been available wh Solomon built his temple at Jerusalem, pr bably with his wealth he would have pr ferred it to the cedar of Lebanon; it however, used in the Pagodas of the East, an as a preferential treatment to our greate dependency, it is to be hoped that it will the one wood used throughout in the buildi of the great cathedral of Liverpool.

Teak, whilst it is not difficult to tool, co tains an essential oil which renders it imperis able; as it resists the alternations of damp a dryness, heat and cold, there is in it an absen of swelling and shrinking or warping, so th the architect has at his disposal an excelle wood either for external or internal fittings. high-class work there is hardly any purpose which it could not with advantage be applie Its general uniformity of colour and grain unique. Considering the many high esse tials found in teak, and the remarkab fine sizes obtainable, both in logs and plank and the freedom from defects in the latter, is by no means a dear wood for good wor The best shipments are from Moulmein a Rangoon, the Java wood is too hard and grit for work with much detail.

Having spoken somewhat at length on wh are undoubtedly the three leading fancy woo let us briefly place in alphabetical sequen the minor fancy woods and hard woods.

Amboyna, an Eastern product, whose bota cal position is not well defined, can only used in veneers which form extremely pre panels. It is useful in highly decorative wo In appearance it is not unlike brandy-sna but with more variegation of colour and figu

Ash.—Most varieties are close tough wo and it is used chiefly in vehicular framewo but has neither life nor colour to recommend as a furniture wood.

Quebec Ash, being of a milder texture, was or a time used in moderate-priced bedroom urniture, but its increased cost and the diffi-ulty of getting it free from discolouration auses it to fall into disuse.

Hungarian Ash is frequently richly figured, out its varying grain, unless special care is aken in laying the veneer, allows the glue to liscolour it; this, with the cost of labour, puts t out of the running.

Beech, whilst it is a useful material, it annot be classed as a furniture wood, unless t be for cheap chairs.

Birch was, for a time, in vogue for bedroom suites, when everything was veneered; it is now only used in cheap chairs, and the frames or stuffed chairs; and for other purposes re-quiring hard wear it is a useful, cheap wood.

Black Ebony.—Of the many varieties, the argest comes from Ceylon; then there are the shipments from East India, Calabar, Mada-gascar, and Mauritius; logs come in the round, 3-15 inch to 3 feet and longer. The wood s extremely dense, and is highly suitable for small ornamental work. When applied to decorative fittings, it is chiefly used in veneers and mouldings in relief.

Blackwood, from East Africa, is used largely n musical instruments.

Boxwood is essentially an engraver's and rule-maker's material, but it is suitable for small decorative panels, and for handles and shuttles where an extreme hardness is required; n colour it is similar to satinwood. It is im-ported in the round, 3 to 12 inches diameter. The best comes from Persia and Kuysna; that rom the West Indies is inferior.

Brazilwood is used for violin bows.

Brigalow, an acacia from New South Wales, s an extremely hard, heavy, dark-coloured wood, which smells more or less of violets; it s used for small ornamental turnery and fancy obacco pipes.

Californian Redwood or *Sequoia.*—One would hesitate to rank this as a furniture wood; it is a poor material for dovetailing, being short in the grain, and a great ab-sorbent of polish. Considering the large itches it yields, it is a pity that it cannot ake a better position, as the wood is so remarkably clean, but it lacks a cohesiveness f fibre.

Canarywood.—This is distinctively a hard wood, and whilst not a first-class fancy wood, is extremely useful for the inside parts of ttings and furniture. The best qualities are leaner than yellow pine, and the evenness of its texture renders it suitable for staining; the lower grades are largely used for cheap furniture.

Cedar hardly comes within the category of fancy woods, nor is it a hard wood; its character varies, some being very mild textured; it was formerly used for the inside parts of furniture.

Pencil Cedar, of a deep-red colour, with a pungent smell, was formerly appreciated as a moth-destroyer, but it is now almost im-possible to get it in sizes for constructive purposes.

Chestnut in character is something betwixt ash and oak, lacking the medullary rays of the latter, and is much softer; it is subject to ring shakes and the ravages of the pin-worm; it has no beauty to recommend it as a furniture wood.

Cocobolowood is imported in small diame-ters; the wood is dense, and is used in fancy turnery.

Greenheart, from British Guiana, is shipped in hewn logs, 12 to 20 inches deep, 20 to 40 feet long. Its chief use is in dock-gate con-struction; it is long in the fibre and dense in texture, but there is nothing in its colour and appearance to justify its adoption in general work, and it is difficult to tool.

Curupay, like most of the South American woods, is extremely hard, heavy and potty, it is neither a mahogany nor a rosewood; when an occasional consignment arrives it is generally neglected by buyers.

Hickory, whilst a good wheelwright's wood, has no feature to commend it for furniture.

Kingwood or Violetwood is used for orna-mental handles and similar purposes.

Lancewood is a splendid material for shafts, but it hardly comes within the scope of our observations.

Letter or Snakewood, a fine ornamental timber, which is used for fancy walking sticks, &c.

Lignum-vitæ, without doubt, the hardest product of the tropical forest, is invaluable for many purposes, but for decorative work it is too difficult to tool, and it has no beauty.

Jarrah.—A hard dense wood of no beauty in appearance; considering the large sizes to which it grows, it is a pity that its uses in this country do not appear to be available for much beyond that of a paving material, for which it is undoubtedly fitted, as it can be obtained clear of sap; but this is hardly the time to discuss the relative merits of hard wood paving.

Karri.—A similar wood to Jarrah, but of

much greater tensile strength; to a small extent it is being used for the under parts of rolling stock, but whether it will be found to possess or retain that flexibility so characteristic of oak, remains to be proven, and its great weight adds materially to the dead load of the train. There is nothing in its appearance to command it for general purposes.

Maple is too insipid in appearance for furniture, &c., unless we except the bird's-eye variety. Its chief uses are for the interior of tramcars.

Plain hard Maple makes an excellent factory or ball-room floor, as it does not shell in the grain. It is used in machinery, and for washing-machine rollers.

Myallwood is used for purposes similar to that of brigalow.

Olivewood does not enter largely into our imports. In closeness of grain and colour it is not unlike satinwood, but it is variegated with many dark streaks. It is, however, a useful fancy wood for knick-knacks.

Padouk is shipped from the Andaman Islands in fair sized, hewn logs; is of a deep red colour, which fades with exposure. It will not take glue. When wrought it stands well, but it is costly to manipulate. Where extreme hardness is required, it makes a good countertop, but the general run of lengths are too short. It is also a splendid wood for gun carriages, &c.

Partridgewood is occasionally used for furniture, also for fancy knick-knacks and walking sticks.

Rosewood thirty years ago was considered a first-class drawing-room furniture wood, but it has fallen into disfavour, although it is still used for pianoforte cases. As a wood it is costly and the sizes small, and is difficult to work. When newly worked it possesses a dark and frequently richly variegated figure, but fades with age, becoming very lifeless. As a moulding wood in relief it is very effective.

Sabicu, a hard dense wood shipped from Cuba and the West Indies, occasionally from Africa, is used by naval constructors, and where hardness is a desideratum, it makes a capital countertop, but for work with much detail there is nothing in its appearance to justify the labour.

Satinwood is probably the gem of the forest, but the quantity available is small, and where used the style should be so arranged to adapt it to the sizes available. In texture and figure it is closely allied to Spanish mahogany, but the colour is of a pale lemon tint. Its appearance when finished justifies any labour which may be necessary.

Sycamore is white in colour, and whilst it is a good kitchen wood, there is nothing to recommend it as a general furniture material.

Thuya is the burr of the cedar and makes an excellent veneer for panels and inlaying, but the colour and figure is not so fine or rich as that of amboyna.

Tulipwood, a small fancy wood used in veneers and inlaying.

Walnut, up to the seventies, when veneering was in vogue and the hours of labour longer and wages lower, Italian, Circassian and English walnut was largely used by the cabinet-maker; the burrs of the two former yield pretty and varied figure; the pianoforte case makers still use it largely. With the change of style in domestic furniture and the more general adoption of fancy woods in general fittings, there arose a demand for black walnut; its large mild growth lent itself to the new need, but owing to the depletion of supplies it is now difficult to get logs, clean and suitable for large work; there is no doubt that for a while walnut will continue to arrive, but it will be chiefly ill-grown harsh small wood. There is a quantity of low grade timber arriving for the cheap furniture trade, but the few large and prime logs and first quality lumber will always command high prices, and it is not an economical wood to convert and manufacture.

The colour and coarseness of texture and general pottiness of the South American and Corinto walnut render them unsuitable for this market.

Satin-walnut (so-called) is in reality a gum-wood and is used for cheap bedroom suites. Whether it will prove to be a good paving material you have in this city an opportunity of ascertaining.

White walnut, or butternut, is a mild-textured wood, but in colour too insipid and the supply very insignificant.

Yew-tree, on account of its flexibility, is used for archer's bows; occasionally the trees yield a fine figured burr suitable for panels.

Zebrawood, a tropical product, as its name implies, is stripy in colour, and is used for inlaying.

Incidentally it may be mentioned, that apple, cherry and pear, are close, even textured woods, which may occasionally be obtained for carved panels; they are also useful for ebonised veneers and mouldings.

It is not, for one moment, claimed that the list given represents all the fancy woods, but

ie endeavour has been to keep within the tle of the paper. Comparing the woods enu-ierated with a good botanical guide, one annot fail to notice the limited range of 'oods which have commanded a position.

The method of shipping sample woods is either satisfactory to the shipper nor to the ·ade on this side.

Mr. Gamble, in his lecture at the Royal Colonial Institute, spoke of the difficulty of ıtroducing new woods, which is quite true.

Merchants and consumers here have also normous obstacles to face if they attempt to ush an unknown wood. Unfortunately timber annot be assayed as readily as a mineral. If he former is to be properly assessed, it must rst be thoroughly seasoned; to do this takes ime.

Very few people can determine the hemical constituents of one wood as com-ared with another, nor are there many who ave capital to sink on a wood for which iere is no market or demand, and for which ie fashion has to be created.

The carrying of seasoned stocks of recog-ised fancy woods is in itself a heavy tax on apital, without loading it with an unknown nd unproved wood, and if a merchant takes ie risk he has no guarantee as to the con-nuity of supply at a price that would enable im to compete with recognised stocks. Vhy should an architect specify in his con-acts any woods which may prove to be nattainable.

Can there be any wonder then, as was re-arked by a speaker in the discussion on Mr. ammell's paper "that merchants do the ain business thing, and stock such woods s mahogany and oak?" The introduction of ew woods involve a considerable amount of issionary enterprise, which rightly should elong to those whose interest it is to secure eir introduction and acceptance. Primarily ie trade here is not concerned as to what range wood may be waiting for the logger, s engineers and architects naturally specify ose woods which are known to commerce id approved by experts.

Native woods may no doubt fitly meet the eeds of a primitive civilisation; but in this untry there is the choice of proved products the forests of the world; and so long as this the position, there is no inducement for the ilway carriage builder, for the sake of saving ten pound note in a £1,200 carriage, to risk t only the lives of passengers but his own putation. It is astonishing how few new woods have made a position during the present generation.

This much, however, is certain, that should the present demand for fancy woods and hard woods continue, there must in the near future be new sources tapped, and there is a golden opportunity for anybody who could find, ship and maintain a continuity of supply of woods at present unknown or unrecognised, but these must at least possess some of the essentials enumerated at the outset, and be able to compete in price with the recognised imports.

It is, however, futile to send here un-labelled samples which brokers cannot classify, and consequently give them such unmeaning names as "fancy woods" or "furniture wood," and hence they are frequently auctioned at prices which do not cover freight and charges.

If a wood is worth sending it should have proper foster-parents, who can give the trade some idea of the quantity available, and the more important question as to the continuity of supply and the cost at which it can be placed on the market.

If, however, a wood is of great specific gravity, this adds materially to the cost of freight, and it will be difficult to work; this is another factor against its general adoption, so long as mild and free working fancy woods are available. Nor should it be expected that initial shipments will prove to be a gold mine to the consignors, but any wood possessing a fair share of the essentials laid down, if properly sponsored, is bound to force a market if backed up with sufficient missionary enterprise, but whether this work should be undertaken by the individual company, or the Government at the point of origin is a matter for them to settle amongst themselves. I have endeavoured to show what is required of woods if they are to find a place in our commerce, and I may add that there can be no doubt but there are as yet vast tracts of virgin tropical fancy woods unexploited. One looks forward with considerable interest to the enormous possibili-ties which the completion of the Panama Canal will afford modern enterprise in opening up the virgin districts on the Pacific coast. Our Consuls there should do something to grasp the position before it is found that the Americans have obtained concessions and monopolised the best supplies.

In conclusion, whatever may be the outcome of the present fiscal inquiry it is sincerely to be hoped that the products of the forests, especi-

ally tropical (as they are essentially our raw materials) will be accorded the most favoured clause, if not admitted absolutely duty free.

DISCUSSION.

The CHAIRMAN said that he was sure that they would agree with him in regarding the paper as a very interesting one. The question of timber supplies had always been one in which the Society of Arts had taken a great deal of interest. More than a hundred years ago the Society spent a large sum of money in encouraging the reafforesting of the country; and now the Society did its best by encouraging the reading of papers on the subject to supply the deficiency which was admitted to exist in the supply of timber. Whether as a building material timber was to be entirely superseded by concrete and iron, it was not for him to say: but perhaps one reason why timber was not used as much as formerly was the difficulty of supplying it in sufficiently large quantities for building. He was quite sure that it would be extremely difficult now to supply timber for such enormous beams as those which supported the floor of the room in which they were now met. Those beams extended from wall to wall, and they had no intermediate support of any kind. He thought that an architect who had to build a new room for the Society would hesitate to specify for beams of that character and if he did, the contractor would find it very hard to obtain them. But there was no doubt that timber would never be superseded as a material for furniture. It was probable that many persons would have been struck by the enormous variety of timbers which Mr. Tiffany had mentioned as available for such purposes as furniture. Those persons who wete interested in this subject he would refer to an old and very interesting book, Holtzapffel's Mechanical Manipulation, a work which contained a vast amount of information on its own subject. In the first volume of that book, published in 1843, there was a very full and very useful list of woods which were used for practical purposes such as turning, building, and the like. He should like to ask Mr. Tiffany whether he considered that the Afiican mahogany which we now got was at all equal to the old so-called Spanish mahogany which was obtained from the West Indies. He had always understood that the African wood was of a distinctly inferior character. We did not now get such large supplies of mahogany from Central America and the West Indies as formerly, and he would like to know the reason. Mr. Tiffany had spoken very well of teak as a material in construction; his own slight experience of teak was that nearly all his time was occupied in keeping his tools sharp. The specimen which he was unfortunate enough to get hold of seemed to be a singularly siliceous timber, and it had a frightful apacity for taking the edge off planes and turning tools.

Mr. E. T. SCAMMELL said that he had listene with a great deal of interest to the paper. It wa crammed full of useful information. He agreed tha it was very necessary that our timber supplies shoul receive more attention. He hoped that the questio of reafforestation and cognate matters would b dealt with both in this country and elsewhere. Mr Tiffany had referred to the Australian woods, jarra and karri, and also to Australian mahogany, and as t the last-named he had said that there was very little c it that could be used for furniture. Australian ma hogany was simply a variety of eucalyptus, of whic jarrah and karri were conspicuous examples. I Western Australia jarrah was often called ma hogany. He did not agree that jarrah an karri were not beautiful woods. Curly jarral was particularly beautiful. There was a larg number of Australian woods which ought t be introduced for furniture. They had a beautifu figure and possessed the qualities to which Mr Tiffany had referred as being desirable in fancy wood and furnitnre woods generally. He could have wishe that Mr. Tiffany had given the botanical names o the materials that he had mentioned. He had, how ever, succeeded in furnishing a poplar *resumé* of th whole subject. He (Mr. Scammell) agreed with Mr Tiffany as to the difficulty of introducing any nev wood. He did not know who was to blame, but h knew of cases in which Tasmanian woods had bee sent to the English market in such a condition tha it was impossible for justice to be done to them. H should like to ask whether Mr. Tiffany thought i desirable to introduee a method of preserving woo or bringing about artificial seasoning in the case o some of those valuable timbers which were being rapidly exhausted. He should like to hear Mr Tiffany's opinion as to accelerating the process o seasoning by kiln drying or in some other way. H (the speaker) was personally very much interested ir a certain process which was called colloquially "the sugar process." He (Mr. Scammell) had had under hi hands that day some excellent specimens of polishec wood which had been processed by the sugar treat ment. On some of them, particularly elm and poplar the polish was extremely beautiful, and the woo had assumed an entirely different appearance in consequence of the treatment. The process consiste simply of boiling the timber in a solution of sugar anc water in the proportion of 3 lbs. to 4 lbs. to the gallon and then passing the timber into a drying chambe heated up to 200 or 250 degrees. The process seeme to him to afford the possibility of taking green wooc and turning it into a perfectly seasoned and maturec material. The seasoning was done without injury tc the timber.

Mr. H. STANNUS said that he had been very much interested in the paper, but he regretted that Mr. Tiffany had attempted to cover too large a field by dealing with constructive as well as decorative wood. He also could recommend the work by

Ioltzapffel to which the Chairman had alluded. That ork was a mine of information, and was well worthy e attention of every young man, who was studying oods. Mr. Tiffany had remarked that certain woods ere unsuitable for Chippendale and Sheraton furni- ıre, and he thereby tacitly condemned the woods. Ie (Mr. Stannus) would prefer to state the matter the ther way, and say that the particular styles of heraton and Chippendale were unsuitable for certain oods. An artist would disregard the names which ere adopted to puff furniture, but would apply a tyle which would be most suitable to the character of e wood of which he made use. He (Mr. Stannus) id not like the expression in the paper, "cheap ırniture." All furniture was cheap if it was ood, and expensive if it was bad. Mr. Tiffany ad said a good deal deal about reafforestation, and robably all would agree with what he had said. As getting labour "back to the land," what land did Ir. Tiffany mean. If he meant the land of Great ritain, it must be remembered that the decora- ve woods were grown in foreign lands. Mr. iffany had admirably stated that it would be futile send examples of strange woods to this country, ecause British furniture manufacturers would not ke them up unless they were satisfied on the points f durability and of continuity of supply. But in aking this statement at the Society of Arts, Mr. iffany was, of course, preaching to the converted. rtists were exceedingly careful and shy about using ew woods, unless they were certain that the woods ould be procured continuously and "matched," as e ladies would say. But it was to be hoped, con- dering the international character of the Society of rts, that the paper would find its way into the ands of our consuls and merchants in tropical coun- ies, and that those persons would lay to heart what e writer had said. He regretted that Mr. Tiffany ad not brought samples of wood to the meeting.

Mr. W. EDGAR GRAHAM, referring to the Chair- an's remarks as to the shortage of Spanish maho- any in this country, said that it was due, to a great tent, to the trouble of getting the wood to market, d another difficulty was the question of freight. o timber could be got to market unless it could floated down a river. It could not afford y other mode of carriage. The Spanish ma- gany came chiefly from Cuba, and the forests were nse with the finest wood that was ever grown; but could not be obtained unless perhaps the Americans olved some cheap method of bringing it. The panish mahogany which came from San Domingo as undoubtedly small, as the reader had said, but was always considered the finest wood for dining bles. The ordinary Spanish mahogany which came om Cuba aged into a uniform dark colour, but the n Domingo mahogany always maintained its con- ast of colours, however dark it got. Honduras ahogany grew large, and was extremely good for neering purposes, and, being a free-growing wood, it did not split or warp. There could not be a better wood for constructive purposes. As to Honduras cedar it grew very large, and there was no figure on it. There was no better wood for drawer bottoms. As to oak, the material which was generally known in this country as "English crown riga" was the best quality of Russian oak, the second quality being called "Dutch crown." The English crown was con- sidered by cabinet makers the finest oak grown, and would not either warp or twist. Austrian oak was a little milder in quality, but the Austrian people stripped it of its bark for tanning purposes before the wood was seasoned, and thus rendered the wood subject to large sun shakes and great waste. Odessa oak grew larger and freer than the oak of the north, but it was an equally good wood. A homely wood grown in this country was beech. He knew of no better wood for chair frames. There was one peculiarity in all woods, and particularly in beech and oak, and that was that they should always be cut and dried in the thicknesses in which they were to be used. Oak was a very slow drying wood, and only seasoned at the rate of one inch a year. A seven- inch balk would require seven years to dry, and a balk of more than seven inches thickness would never dry thoroughly.

Mr. A. R. SMEE said that woods grown in tropical and swampy districts were absolutely unsuit- able for furniture. Such woods had been several times introduced into England, but they had always had to be given up. They were all awkward for working up and blunted the tools, and they would not stand the English climate. He heartily agreed with everything which Mr. Graham had said.

Mr. TIFFANY, replying to the discussion, said he thought that to-day very little of the fine old Cuba mahogany came into the country. With regard to our timber supplies we were in the position of having to bow down to the god of cheapness. English manufacturers were standing aside and allowing the Americans to outbid them for the best supplies of mahogany, and the Americans were absorbing nearly all the central American supplies. As to African mahogany it grew really in the same latitude as the Spanish, and some of it was remark- ably fine wood. The fact of the price being from 5s. to 12s. 6d. a foot showed that the wood was of no mean order. What had been said with regard to water carriage was quite true. In tropical climates there were great undergrowths of wood, but no roads by which the timber could be brought. Nicaragua afforded an example of this. Mr. Graham had alluded to British crown and Dutch crown oak. Those terms applied to the Riga and Memel shipments. But those timbers were positively "back numbers." To-day there was no timber shipped from those places. The Austrian and the Odessa oaks were competing, but the old classifications under the Memel and Riga shipments were not now in existence. It was remarkable that architects were so

slow in realising the changing conditions which were ever affecting the timber trade. He was quite at one with the speaker who said that it was desirable that timber should be cut at the outset fresh from the log into the thicknesses into which it was to be used. One of the greatest objections to Kauri pine—a wood which he had not mentioned—was that it was cut into great flitches and sent over to this country to be afterwards cut up into smaller pieces. The warping to which this wood was subjected he attributed entirely to the fact of the outside being drier than the inside.

A vote of thanks was accorded to Mr. Tiffany for his paper.

Miscellaneous.

THE FRENCH LACE INDUSTRY.

The manufacture of lace in France dates back to the days of Louis XIV. In the month of August, 1663, the famous "Declaration du Roy" was published decreeing the establishment in Arras, Rheims, Sedan, Alençon, Aurillac, and other towns in the kingdom of all kinds of thread and needlework after the manner of the points made at Venice, Genoa, Ragusa, &c. They were to be called "poincts de France," and the decree provided that such work should be done free from duty. In order to encourage the industry in the country another decree dated October 12th, 1666, forbade any person of any quality or condition to wear under pain of confiscation of the articles and £1,500 fine any Venetian or other foreign lace no matter of what kind. The following year a second decree was issued forbidding the wearing of any dress with silver or gold facings made outside the country. These decrees also forbade the manufacture or sale of any lace other than that made in the royal manufactories and according to the designs of the directors of the establishments. Colbert, the minister of Louis XIV. was the chief instigator of these Draconian decrees. He obliged the manufacturers to make only one point or design to the exclusion of any other. A large number of localities only obtained their living by the kind of lace familiar to them, and everywhere it was believed that the opening of manufactories whence henceforth designs were to be issued, would cause ruin. But the real aim of the Government establishments had not been understood, which was to perfect the industry, in providing models, designs, and methods of execution, constituting precious elements for the improvement of the ordinary manual work. For twenty years Colbert had to contend with popular prejudice on the subject, but he finally triumphed, for it was through his efforts that the admirable "poinct de France" took rank among the arts and industries of the country.

In a recent report to his Government, the United States Consul at St. Etienne says that to-day, in spite of the progress of machine-made lace in the numerous manufactories of the northern and eastern Departments, the hand-made article holds a high rank. The lace-makers (women) throughout the country, not being organised or syndicated after the manner of other workers, it is difficult to state exactly the number of those who work at this industry, but it does not fall short of 200,000. The wages are small, and in some cases a clever lace-maker will not earn, for twelve or fourteen hours work, more than one shilling and threepence a day. In the country round Caen, Bayeux, and Falaise, in the Calvados, where formerly a good deal of lace was made, the inhabitants have decreased by 27,182. In the same Department, in 1851, there were 50,000 lace-makers, while in 1895 they had fallen to 30,000. Yet in spite of the extraordinary improvement in the machines, the lowering of the wages and the decline of public taste, the hand-made lace industry holds a good many centres.

Alençon still produces its famous "point d'aiguille," which enjoys so much favour and employs so many workers (10,000). Hand-made lace is found all along the northern coast—Cherbourg, Honfleur, Bolbec, Fécamp, Dieppe, Bayeux, Falaise, and Lisieux. At Honfleur and Dieppe a special kind is manufactured imitating Valenciennes. But the most active centre is at Bayeux where Chantilly lace is manufactured. Flanders, the cradle of the lace industry, has lost much of its prestige; while Lille and Arras produce but a small quantity of cheap grades. For Valenciennes, the town celebrated above all others for its lace, the nimble fingers have ceased to ply "fuseau" for nearly a century, although in certain places such as Bergues, Cassel, Hazebrouck and Bailleul, an imitation of this fine lace is manufactured. In the Department of the Vosges, and at Mirecourt, a very fine imitation of Brussels point is made, and 20,000 to 25,000 women still work it.

Lace-making is the principal industry of the Haute Loire. The wives and daughters of the farmers are to be seen everywhere in the most remote villages as well as in the towns turning the spindle of the cushion set on their laps with surprising agility. Lace-making in the district is said to have been brought from Italy at the time when the pilgrimage to the Black Virgin of Le Puy was at its greatest activity. At the time when men wore ornaments and finery unknown to our day, lace was ardently sought to set off the clothes. In spite of the distance from the great centres of industry, the Haute Loire took a prominent place by the side of Flanders and Alençon. This was due in great part to the cheapness of the hand work, the natural aptness of the women, the proximity of Lyons where the fine Holland thread could be obtained, and above all to the neighbourhood of Beaucaire. For a long time, Spain and her immense possessions constituted one of the principal markets for Le Puy. Those markets lasted until the

[en]d of the 18th century. This period coincided [wit]h the waning of the inventive minds of the manu[fac]turers, and the lace deprived of its best customers [wa]s threatened by the simplicity and austerity of the [ne]w fashions, with destruction. The catastrophe [wo]uld have happened had it not been for a manufac[tur]er, called Falcon, who endeavoured to work [aga]inst the abandonment of lace-making, by com[ple]tely renovating the industry which, in a short time, [on]ce more became prosperous, and at the present [tim]e the lace-makers of this picturesque Department [ha]ve attained well-merited fame. For this reason, [Ge]neral Gallieni, the Governor of Madagascar, re[ce]ntly applied for, and obtained a few of the best [art]isans of the Haute Loire to introduce lace-making [int]o that island, believing that in time the Malgache [wo]men may become experts. For this purpose, he [or]ganised a school where the art is taught to [ch]ildren alone. In the Haute Loire the number of [wo]men lace-makers is computed at 60,000, while [ab]out 30,000 more are scattered through the neigh[bo]uring Departments. The picturesque City of Le [Pu]y organised last summer a local exhibition of art, [in] which lace held an important place. The lace [ex]hibition was divided into two sections—ancient and [mo]dern. In the former were found very rare speci[me]ns lent by Paris houses and private families. [A]mong these were "guipure of Venice," "Milan [lac]e," "point de France, Louis XIV.," "point [d']Alençon," made for Napoleon I., a magnificent [ha]ndkerchief of Marie Antoinette, &c. The modern [sec]tion was composed almost entirely of the product [of] this region, consisting of fancy handkerchiefs, cor[sa]ges, sleeves, collars, cuffs, appliqués for dresses and [ha]ts, cushion and pillow covers, curtains, tablecloths, [&c]. In conclusion, it may be added that the French [Go]vernment, recognising the importance for the [co]untry of the development of the lace industry, has [ins]tituted the professoriate of hand-made lace in the [pu]blic schools of Departments where lace is manu[fac]tured, and also in the normal schools of the same. [Fu]rther, special district technical schools for improv[in]g the artistic education of the work girls and de[sig]ners, are about to be opened in certain centres.

NORWEGIAN COD LIVER OIL.

Pure cod liver oil has for some time been a scarce [art]icle in the world's markets, owing largely to the [ma]ny admixtures and adulterations used by un[scr]upulous and careless manufacturers. The best [No]rwegian oil is extracted from the fat livers of the [co]d in the early part of the winter fisheries in the [Lo]foten Islands. The livers at this time, in January, [Fe]bruary, and a part of March are as a rule, light [co]loured, plump and very rich in oil, which is ex[tra]cted after careful sorting of the livers, with simple [ma]chinery, by steam. The product is as clear as [cry]stal, nearly tasteless, and without smell. The islands present many advantages over other places for the production of strictly pure oil. The shoals of fish seek the shore for spawning purposes and the banks are so near land that the boats sometimes land two catches in one day, consequently the livers are, except when stormy weather interferes received fresh at the factories daily. The United States Consul at Christiania says that the average annual catch of cod in the islands is 30,000,000. Unlike other districts in the country, the cod at this time of the year is about the only kind of fish caught, so there is less opportunity for mixing the livers from cod with those from inferior fish, such as pollock, ling, haddock, tusk and others. Oil from these contains less fat, the colour of the oil is darker, and its medicinal properties are of less value. Oil from these and other inferior fish may be bleached by exposure to the sun in glass coverings, and by various chemical processes. Experiments have been made in Norway for manufacturing cod liver oil on board ships located among the fishing fleet in the open sea, but it has been found that the ship's motion had a detrimental effect on the oil thus produced. Establishments on shore in places where unmixed cod's livers can be obtained fresh every day, are found to be the best. The livers have to be carefully cleaned, and only those of the right colour selected for medicinal oil. The year 1903 was an exceptional one as regards the Norwegian winter cod fisheries. In ordinary years, the shoals of fish arrive in the beginning of January, but last year no fish whatever appeared before the middle of March, and they were then found to be in such poor condition that only a very insignificient quantity of oil was provided—only 3,000 barrels against 30,000 barrels in ordinary years. The quality of the 1903 output was also, as a rule, poor. It is estimated that in ordinary years the livers of 4,500 cod are required to produce a barrel of 30 gallons, of medicinal oil, while 40,000 livers were required in 1903 to produce the same quantity. Cod liver oil can be properly tested as to purity by chemical analysis only. Where large quantities of oil of inferior grade are added, it can be detected by experienced people without any scientific test simply by the difference in taste and colour. Fears have been expressed that the conditions ruling the Lofoten fisheries in 1903 will also make themselves felt in 1904. According to recent reports the Greenland seal has again appeared in great numbers in the bays of Finmarken. Before 1903, the Greenland seal was never fonnd near the Norwegian coasts in any number, but that year they came in large shoals as early as January, and the fishermen believe contrary to the views of scientific men that they were the cause of keeping the cod so long away from its customary spawning places. It is generally believed that the Norwegian winter cod is the very same species of fish as appears and is caught on the banks of Newfoundland, but it differs from the common cod caught in all seasons of the year.

TOBACCO CULTIVATION IN THE TRANS-CAUCASUS.

The tobacco plant is cultivated at Kahetia, at two points, viz., the town of Signah, on the right bank of the Alazani, and in the flat country lying about Lagodeh, and the fields of the villages adjacent thereto. Of recent years, the production of tobacco in the Signah region has developed and improved to such an extent that the crops have yielded better returns from the plantations in and around Lagodeh. It would appear that plantations on an extensive scale in Kahetia are few and far between, and the largest single areas under tobacco cultivation do not exceed 27 acres, the bulk of the tobacco being grown on plantations not exceeding from one to five acres. The quality of the tobacco grown in the district having any commercial value, appears to be exclusively that known under the name of Trebizond tobacco; other qualities as, for instance, Samsoon and Dubeck, are cultivated in exceedingly insignificant quantities, and therefore are of no commercial value; the latter mentioned tobacco is sold at the same rates as the Trebizond quality. Trebizond tobacco is subdivided into two qualities locally known under the names of Lagodeh-Trebizond, and Trebizond Platana. The first-mentioned quality has been grown for a great number of years; on the other hand, owing to the distribution of the seed among planters by the Department of Agriculture, the Platana quality was only introduced into the district at a comparatively recent date. The difference in the two qualities spoken of above consists in the following:—The Lagodeh-Trebizond is considerably superior to the Platana. The plant contains a considerable number of leaves, the sizes of which are larger than those of the Platana plant; they are of a round shape, whereas the leaves of the Platana is oblong. The so-called Lagodeh-Trebizond being superior in quality and colour, as a rule yields a heavier crop; planters therefore give this quality of tobacco the preference. There are but few plantations on which Platana tobacco is cultivated, but this tobacco is frequently to be seen intermingled with the Lagodeh-Trebizond plant. The Platana quality, however, is gradually acquiring the favour of tobacco planters, and the demand for the seed is annually increasing. Tobacco grown in the district of Signah is considered to be of better quality than the Lagodeh tobacco, but the manipulation of the leaf is carried out with greater care in the Lagodeh district, where cultivators of tobacco are in general better acquainted with the industry than their brother planters in the Signah region. The difference in the price of the two tobaccos is not very great. Sales are principally effected during the winter months, but the better qualities of tobacco are generally purchased in the month of November before they are sorted. Unsold tobacco is forwarded from the plantations to the principal towns, where it is placed in depôts, and is there retailed to wholesale dealers. Tobacco is also largely grown in man localities of the Government of Kutais, the Provinc of Batoum, in which the Mourgoul River valley i most celebrated for the high qualities of tobacc which it yields, and again in the district of Soukhoun and throughout the Government of Tchernomoria.

THE FLAX INDUSTRY IN GERMANY AND AUSTRIA.

From trustworthy sources it is calculated that ther are, in the textile districts of Saxony and Silesia, i all 134,238 spindles for the manufacture of line thread. In Bohemia there are about 200,000 spindle and in Western Germany 98,189. It is calculate that each spindle reduces about 300 pounds of com mercial flax per annum, constituting a total yearl consumption of 64,800 metric tons for the enti territory named. Of this quantity about one-third at present home-grown, while the remaining tw thirds are almost entirely imported from the vario provinces of Russia. Flax, to be marketable i Germany and Austria, must, says Consul Muerich Zittau, meet the requirements of the local consume To begin with, the plant should be harvested n with the sole view of saving the seed and its oil, b with an equal regard for the utility of the fibr While the stem may, in cases where the plant is unusual height and the cut very low, be harvested b machinery, yet even then portions of valuable materi become lost, and the only absolutely safe way is to pu up the plant by the roots. Care must also be take that in combing or "rippling" the plants for its see the fibre be not lacerated or stems prematurel cracked. Some of the flax is sold immediately aft this process of rippling—that is to say befo scutching or removing any of the "boon" or woo substance, but there are only a few purchasers wh are prepared to undertake these further processe and it is also believed that the disproportionate co of transporting this article, in the rough, practical precludes its importation in this crude state. Wh it is added that flax in the stem sells on the Germa and Austrian markets for from £4 to £5 per metr ton (2,204 lbs.), the difficulty of importing in th condition can be readily judged. The process "retting" which follows next is customarily accon plished in one of three ways, either by "dew retting that is spreading upon grass or meadow, and allowi the slow process of decomposition to accomplish t desired result—or "steeping" in natural water or tanks of water with a slight addition of heat. The processes certainly take time, but the produ obtained commands the highest prices, and Germa and Austrian manufacturers seem to have a fix objection to flax retted to any extent by quick violent methods. Flax to be saleable must aft retting, be freed of the "boon" in the most approv manner by "braking" and beating or "swingling There is a slight difference in the market price of t

oduct, according to the method employed, that oduced by the brake, selling at prices varying tween £28 to £34 per metric ton, while that sulting from the swingling process commands from 40 to £50.

OTTON CULTIVATION IN THE WEST INDIES.

The *Agricultural News* of Barbados contains much formation respecting the cotton industry in the Vest Indies. It is stated that cotton is planted on a nsiderable scale in St. Kitts and Montserrat, and n a small scale in Antigua, and that the industry romises to be of great importance in the Leeward lands. Some experiment plots have been tried at t. Vincent. The Agricultural Instructor remarks: The planting of cotton experiment plots by the nperial Department of Agriculture at Bequia, has iven the people an opportunity of seeing the proper ay cotton should be planted, and the necessity for lanting the best varieties."

The Barbados Central Cotton Factory was re-pened by the Governor on the 25th January. The ictory is now provided with six gins, a heating press, nd everything necessary for dealing with the present op.

Sir Daniel Morris addressed a meeting of the Agri-iltural and Commercial Society of Antigua, review-ig the objects of his visit to the United States, and iscussing the question of the demand for Sea Island otton and its market. "Merchants and brokers ave," he stated, "no fear of the market being over-ocked and prices depreciating, provided that cotton f first-class quality is produced."

Correspondence.

BRITISH VERSUS FOREIGN PATENT LAWS.

While agreeing with some of Mr. Lowry's state-ents in his letter contained in last week's *Journal*, desire—as one who has had 45 years' experience of ie working of British and foreign Patent-laws, and f the relative merits of these—to offer a few remarks, ith the object of controverting Mr. Lowry's whole-ile condemnation of our Patent-laws as compared ith those of the United States and Germany, and of iowing that the former, as amended by the Act of 902, is certainly more advantageous to the inventor ian either of the other laws.

In the first place, I would point out two erroneous atements in Mr. Lowry's letter. Firstly, he states iat if a workman makes an invention his employer in take out a patent for it, merely rewarding the ventor by an increase in his wages. This, as is ell known, is not the fact; the employer, in applying for the patent in his own name, has to declare that he is the inventor of the invention in question; and if it can be subsequently proved that he was not the inventor, the patent will be declared void by the Courts, just as much as though he had made a solemn oath to that effect, as is required in the United States. To obtain a valid patent the workman's name *must* appear in the application, and consequently he must be at least part owner of the patent, and he is therefore in a position to impose terms on his employer.

The second mistake is as to the relative cost of obtaining a British and a United States patent. The Government fees for the latter Mr. Lowry states correctly at £8, but those for the former he incorrectly states to be £15 ($75); as a matter of fact, they are £4, and there is nothing more to pay for four years. It is true that the £8 for the United States patent is the total Government charge for the whole term, while for England annual taxes have to be paid after the fourth year, but that does not do away with the fact that while the United States workman has to pay £8, cash down, to obtain his patent, the English workman has only to pay £4, and has four years in which to get his patent taken up before he has to pay anything more.

I quite agree with Mr. Lowry that the subsequent taxes for the British patent are excessive, and that it is wrong in principle to make the revenues of the Patent Office a source of income for the State; the patentee should be made to pay no more than is absolutely necessary for defraying the expenses of the department, and for affording the inventor the greatest possible facilities for gaining information on technical and scientific matter. I therefore consider that in view of the ample funds in the hands of the Patent Office, derived from the said taxes, the imposition of a further charge of £1 for defraying the cost of examination under the Act of 1902 is not at all justified.

The main point, however, in Mr. Lowry's statements from which I entirely dissent, is that in which he puts forward the United States and German Patent-laws as being much more to the advantage of the inventor than the British law. This, from the long experience I have had of the working of all three laws, I must distinctly deny; and here I assume the British law as it now stands amended by the Act of 1902, whereby the applications for patents are to be examined as to novelty, and prior patents that, in the opinion of the Comptroller-General or of the law officer, more or less anticipate the invention, are to be cited by the applicant in his specification, if he decides to complete his patent (a system which I may mention was proposed by me in a paper I read before the Society of Engineers, as long ago as the year 1865).

The United States and German Patent-laws may be well enough in theory, but in actual practice they are tyrannical, and operate to the prejudice of the inventor, inasmuch as in both cases the inventor is under the complete thraldom of an opiniated examiner,

with the result firstly, that he is forced to divide the subject-matter that is covered by one British patent into a number of separate patents, entailing a corresponding increased cost to the inventor. Secondly, he has to argue with the examiner—for years sometimes—before the latter will allow that the inventor has any patentable invention at all, and he may have to appeal (in the case of the United States) first to the Board of Examiners-in-Chief, then to the Commissioner of Patents, and then possibly to the Supreme Court, before he can get his patent allowed, all of which, of course, may run the inventor into very great expense, as patent attorneys and counsel do not work for nothing. Thirdly, the inventor must word his claims, not as *he* considers best for the protection of his invention, but as the examiner thinks fit; and the views of the examiner in this respect are most peculiar, and not conducive to a piain and straightforward expression of the invention, that anyone could readily understand. This is due (I am now speaking of the United States) to the existence of the following four main rules that have been laid down by the examiners of late years :—

Firstly, you cannot have a patent for a method of operating unless this can be expressed entirely without reference to apparatus or machinery.

Secondly, you must not, in a claim for construction of apparatus or machinery, introduce any description of the manner in which it operates—your claim must be limited to the enumeration of the cranks, levers, cams, &c., that constitute your machine.

Thirdly, you cannot in one and the same patent include a method of operation and the machine or apparatus by which that method of operating is carried out.

Fourthly, if your invention is capable of being carried out by several modified arrangements, you must take out a separate patent for each such modification, as each one is considered a separate invention.

The result of all these wonderful rules is that the poor inventor is obliged to go to the expense of perhaps half-a-dozen patents to secure what he has got covered by a single patent in England; that frequently he cannot protect the most vital part of his invention at all, namely, a certain method of operating involved in the apparatus he has invented, and that he has to undrgo interminable arguments with an opiniated examiner before he can convince him that he has any patentable invention at all.

To give an instance of how these rules operate against the inventor, I will draw a claim such as James Watt would have had to be content with, had he endeavoured to patent his celebrated invention in the United States at the present day!

"A steam boiler, a cylinder with piston connected to a crankshaft, a pipe connection between said boiler and said cylinder, a controlled valve device adapted to admit steam through said pipe into the cylinder at regulated intervals, a closed chamber communicating with said cylinder by a pipe connection, a supply of water-spray to said chamber, and a controlled val device adapted to admit the steam from said cylind to said chamber when the piston has performed stroke."

All this jargon being the only way in which W could secure his simple method of condensing t steam in a chamber separate from the engi cylinder.

He would not be allowed a claim for a method operating, because he could not express that meth without mentioning the cylinder and the condensi chamber.

With regard to the German Patent Office, althou they do not insist upon such absurd rules as those the United States Patent Office, the case is just bad as regards the difficulty of persuading the e aminer that you have a patentable invention, and much worse with regard to the number of separ patents you are obliged to take out to cover wl you have got included in a single English patent. an example of the lengths to which the Germ Patent Office goes in this respect, I may mention actual case with which I have recently been co nected, in which, among certain improvements in machine, was a lever, the fulcrum of which was co stituted by a novel device which facilitated its rea mounting and removal, while at another point it w connected to another piece of mechanism by an i proved connecting device that also had the object facilitating its mounting and removal. The Off obliged my clients to take out a separate patent each of these devices, although they both related one and the same lever, the argument being, th unless two improvements on one and the sa mechanism have a definite relation to each oth which necessitates their being used in combinati they have to be considered as separate inventio and, as in the above case, each of the improveme could be used independently of the other one, th were, in the eye of the law, two separate inventio The result of the action of the German Patent Off in this matter was, that my clients had to take five patents (even after dropping their claims to t or three of the improvements) for an invention th was covered by a single British patent, thus involvi them in a total expense for taxes, for keeping these patents, of £1,312 10s., as compared with £ for the British patent.

But now I must come to the crux of the wh matter. If by the ultra-strict examination as novelty to which the United States and Germ applications are subjected and the consequent refu of patent rights to a very large proportion of the the fortunate owners of the patents granted obtain an indefeasable right, secure against all attacks, o might put this as a considerable set-off against above-described serious disadvantages arising out the manner in which the law is administered in th countries. But alas, this is by no means the ca In the year 1897, when, as President of the Charte Institute of Patent Agents, I was preparing my

ugural address,* which touched upon this vexed uestion of examinations as to novelty, I took the rouble to ascertain, in each of the principal countries, he number of patents that had been subject to litigaion during the preceding year, and the number of hese litigated patents that had been declared wholly r partially invalid in the Law Courts, and I found he following astonishing facts :—

PATENTS OF THE YEAR 1896.

Country.	Patents granted.	Patents litigated.	Patents declared wholly or partially invalid.
Great Britain	14,105	29	13
Germany	5,410	102	43
United States....	21,867	198	54

So that under the much vaunted system of strict xamination as to novelty, practically just the same roportion of the litigated patents were declared void 1 Germany as in Great Britain. In the United States the proportion was more favourable, and of ourse for other years the proportions may have been ifferent as regards Germany and England, but the tartling fact remains that for a year taken quite at andom (I simply took the last available records at he date of my presidency) with so strict an examinaion and weeding out in Germany, that out of 16,486 pplications, only 5,410 patents were granted, these vere no more secure against annulment than the English patents.

Where then is the great advantage of the German nd United States systems to the inventor that Mr. Lowry endeavours to show? Is it not proved by the bove statements that the advantage is entirely the ther way about, and that it is not in England that invention is smothered instead of being fostered" y the Patent-laws, but in Germany and the United States?

Allow me, in conclusion, briefly to enumerate the olid advantages that an inventor obtains under the British Patent-laws, as compared with those of Germany and the United States.

1. He can provisionally secure his invention for nine nonths at a Government charge of only £1.
2. He can obtain a complete patent for £4, having othing more to pay for four years.
3. He is not bound by any absurd rules in the raming of his claims, but can word these in the nanner considered by him or his professional adviser o be best adapted to effectually protect his invention.
4. He can include in one and the same patent, ubject-matter for which he may probably have to ake out a number of separate patents in the other ountries, involving great additional outlay.
5. He does not have to battle for dear life with an bstinate and prejudiced examiner, and be kept in suspense for months or years as to whether he will obtain a patent or not, involving him in a corresponding additional expense for appeals, &c.; he is simply obliged to mention in his specification those prior patents which the Comptroller-General or the Law Officer consider more or less anticipate his invention.

I fear I have trespassed greatly on your space with this letter, but the subject is of great importance to many of your readers, and I think it is high time their eyes should be opened as to the real facts respecting the much vaunted German and United States systems of examinations and control over the patents granted, and the chimerical nature of the advantages supposed to be derived therefrom by inventors and manufacturers. CHAS. D. ABEL.

Birkbeck Bank Chambers,
Southampton Buildings, London, W.C.
Feb. 22, 1904.

* Should any of your readers desire further details in this natter I shall be pleased to send them a copy of this address.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock:—

MARCH 2.—"Physical Degeneration." By ROBERT JONES, M.D., B.Sc., F.R.C.S. SIR WILLIAM CHURCH, Bart., M.D., P.R.C.P., will preside.

MARCH 9.—"Mechanical Piano Players." By J. W. COWARD.

MARCH 16.—"Artificial and other Building Stones." By L. P. FORD.

INDIAN SECTION.

Thursday Afternoons, at 4.30 o'clock:—

MARCH 10.—"China Grass: its Past, Present, and Future." By FRANK BIRDWOOD, B.A. PROF. SIR WILLIAM RAMSAY, LL.D., F.R.S., will preside.

APRIL 28.—"Industrial Activity in Calcutta." By FREDERICK GROVER, A.M.Inst.C.E., M.I.M.E.

MAY 12.—"British-Grown Tea." By A. G. STANTON.

COLONIAL SECTION.

Tuesday afternoons, at 4.30 o'clock:—

MARCH 1.—"Nigeria." By LADY LUGARD (Miss Flora L. Shaw). The DUKE OF MARLBOROUGH, K.G., Under-Secretary of State for the Colonies, will preside.

MARCH 22.—"Cotton Growing in the British Empire." By ALFRED EMMOTT, M.P.

APRIL 12.—"The Regeneration of South Africa." By BEN. H. MORGAN.

MAY 3.—"Canada and Great Britain." By W. L. GRIFFITH.

Applied Art Section.

Tuesdays, at 4.30 or 8 o'clock :—

March 15, 4.30 p.m.—"Recent Developments in Devonshire Lace-making." By Alan S. Cole, C.B.

April 19.—"The Sentiment of Decoration." By Alfred East, A.R.A.

Cantor Lectures.

Monday evenings, at 8 o'clock :—

Charles T. Jacobi, "Modern Book Printing." Two Lectures.

Lecture II.—February 29.—The choice of a suitable Type—The Details of Composition—The *format* of the Page—Margins—Paper—Ink—Presswork—Title Pages—Some conclusions.

Bertram Blount, F.I.C., "Recent Advances in Electro-Chemistry." Three Lectures.

Lecture I.—March 7.—The present position of industrial electro-chemistry—Principal manufactures dependent on electro-chemistry—Major and minor applications—Distinction between purely electro-chemical processes and those performable chemically—Electrolytic refining and winning of metals in aqueous solution: copper, zinc, nickel—Preparation of metals from fused electrotypes: zinc, aluminium, and sodium.

Lecture II.—March 14.—Non-metallic products obtainable electro-chemically—Alkali and bleach, hypochlorites, chlorates—Hydrogen, baryta, nitric acid—Organic substances.

Lecture III.—March 21.—The electric furnace—Calcium carbide, carborundum, graphite, fused quartz carbon disulphide—Phosphorus, iron.

The following course will be delivered on Monday afternoons, at 4.30 o'clock :—

Prof. R. Langton Douglas, M.A., "The Majolica and Glazed Earthenware of Tuscany." Three Lectures.

April 25, May 2, 9.

MEETINGS FOR THE ENSUING WEEK.

Monday, Feb. 29...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. Charles T. Jacobi, "Modern Book Printing." (Lecture II.)

Optical, 20, Hanover-square, W., 8 p.m. Mr. M. A. Dixey, "Periscopic Lenses."

Actuaries, Staples-inn Hall, Holborn, 5 p.m.

Camera Club, Charing-cross-road, W.C., 8¼ p.m. Mr. Percy Macquoid, "Evolution of Form in English Silver Plate."

Medical, 11, Chandos-street, W., 8½ p.m.

Tuesday, March 1...SOCIETY OF ARTS, John-street, Adelphi, W.C., 4½ p.m. (Colonial Section.) Lady Lugard (Miss Flora L. Shaw), "Nigeria."

Royal Institution, Albemarle-street, W., 5 p.m. Mr. Ernest Foxwell, "Japanese Life and Character." (Lecture II.)

Central Chamber of Agriculture (at the House of the Society of Arts), John-street, Adelphi, 11 a.m.

Alpine Club, 23, Savile-row, W., 8½ p.m.

Medical and Chirurgical, 20, Hanover-square, W., 5 p.m. Annual Meeting.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Discussion on following papers:—1. Mr. James Den's Twinberrow, "The Construction o Railway-wagons in Steel." 2. Mr. Arthur Lewi Shackleford, "The Construction of Iron and Stee Railway-wagons." 3. Mr. James Thomas Jepsor Iron and Steel Railway-wagons of High Capacity.

Pathological, 20, Hanover-square, W., 8½ p.m.

Zoological, 3, Hanover-square, W., 8½ p.m. 1. S Charles Eliot, "Some Nudibranchs from Zanziba and East Africa.—No. IV.: Dorididæ Crypto branchiatæ." 2. Mr. Robert T. Leiper, "*Avagin incola*, gen. et. sp. nov., with a Note on th Classification of the Proporidæ." 3. Dr. Eina Lönnberg, "Two Specimens of Hybrid Grous with known Parentage."

Wednesday, March 2...SOCIETY OF ARTS, John-stree Adelphi, W.C., 8 p.m. Dr. Robert Jone "Physical Degeneration."

Dante, 22, Albemarle-street, W., 8½ p.m. Mi Catherine Phillimore, "Aleardo Aleardi."

Sanitary Engineers, 19, Bloomsbury-square, W.C. 7 p.m.

Royal Archæological Institution, 20, Hanove square, 4 p.m.

Obstetrical, 20, Hanover-square, W.C., 8 p.m.

Society for the Encouragement of Fine Arts, 6 Suffolk-street, Pall-mall, S.W., 8 p.m. M Joseph Offord, "The Last Municipal Election Pompeii."

Thursday, March 3...Royal, Burlington-house, W., 4½ p.r

Antiquaries, Burlington-house, W., 8½ p.m.

Linnean, Burlington-house, W., 8 p.m.

Chemical, Burlington-house, W., 8 p.m. 1. Mi K. A. Burke and Mr. F. G. Donnan, "Chemic dynamics of the alkyl iodides." 2. Messrs. A. (Green and A. G. Perkin, "The constitution phenol-phthalein." 3. Mr. W. H. Perkin, jur "Δ-ketohexahydrobenzoic acid." 4. Messr C. H. Burgess and D. L. Chapman, "Phot chemically active chlorine."

Royal Institution, Albemarle-street, W., 5 p Prof. H. L. Callendar, "Electrical Methods Measuring Temperature." (Lecture II.)

Civil and Mechanical Engineers, Caxton-hall, Wes minster, S.W., 8 p.m. Prof. C. F. Smit "Dynamo and Motor Testing."

National Indian Association, Jehanghir Ha Imperial Institute-road, S.W., 4½ p.m. T Anagarika Dharmapala, "The Training a Teaching of the neglected Village Children India."

Camera Club, Charing-cross-road, W.C., 8½ p. Mr. Edgar Wallace, "The Great Dominion."

Friday, March 4...Royal Institution, Albemarle-street, W 9 p.m. Prof. W. Stirling, "Breathing in Livi Things."

Architectural Association, 9, Conduit-street, W 7½ p.m. Mr. John W. Simpson, "Schools."

Geologists' Association, University College, W.C 8 p.m. Dr. C. Gilbert Cullis, "Remarks on t British Association Geological Photographs."

Junior Institution of Engineers, Westminster Pal Hotel, S.W., 8 p.m. Mr. G. C. Allingha "Some Practical Notes on Electric Stora Batteries."

Philological, University College, W.C., 8½ p.m.

Quekett Microscopical Club, 20, Hanover-squa W.C., 8 p.m.

Saturday, March 5. Royal Institution, Albemarle-stre W., 3 p.m. Lord Rayleigh, "The Life and W of Stokes." (Lecture III.)

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FRIDAY, MARCH 4, 1904.

ll communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

NEXT WEEK.

Monday, March 7, 8 p.m. (Cantor ecture.) Bertram Blount, F.I.C., Recent Advances in Electro-Chemistry." ecture I.)

Wednesday, March 9, 8 p.m. (Ordiry Meeting.) J. W. Coward, "Mechanical iano Players."

Thursday, March 10, 4.30 p.m. (Indian ction.) Frank Birdwood, B.A., "China ass: its Past, Present, and Future."

Further details of the Society's meetings ll be found at the end of this number.

COUNCIL.

At the last meeting of the Council, on onday, 29th ult., Lieut.-Colonel H. C. L. lden, R.A., F.R.S., was elected a Member Council, in place of Mr. R. Brudenellrter, F.R.C.S., who has resigned.

COLONIAL SECTION.

Tuesday afternoon, March 1, 1904; The ke of Marlborough, K.G., Under cretary of State for the Colonies, in the air.

The paper read was on "Nigeria," by dy Lugard (Miss Flora L. Shaw).

The paper and report of the discussion will published in a future number of the *Journal*.

CANTOR LECTURES.

Mr. C. T. Jacobi delivered, on Monday ning, 29th ult., the second and last lecture is course on "Modern Book Printing."

A vote of thanks to the Lecturer for his eresting course was passed, on the motion he Chairman.

The lectures will be published in the *urnal* during the summer recess.

Proceedings of the Society.

TWELFTH ORDINARY MEETING.

Sir William Church, Bart., K.C.B., President of the Royal College of Physicians, in the chair.

The following candidates were proposed for election as members of the Society:—

Barretto, Frederico Demée, Vice-Consul for Mexico, Hong Kong, China.

Bundy, Frederick E., Castries, St. Lucia, West Indies.

Butler, James William, Blyth House, Humber-road, Blackheath, S.E.

Smith, Edward Turner, A.M.I.Mech.E., Lagos, Government Railway, Lagos, West Africa.

Webb, George Arthur, A.I.E.E., P.O. Box 694 Durban, Natal, South Africa.

The following candidates were balloted for and duly elected members of the Society:—

Bousfield, William, M.A., J.P., 20, Hyde-park-gate S.W.

Doulton, Miss Katharine D., 26, Cadogan-place, S.W.

Johnson, Philip Henry, A.M.I.Mech.E., The South African Road Transport Co., Ltd., P.O. Box 45, Kroonstad, Orange River Colony, South Africa.

Read, Charles M., A.M.I.Mech.E., The Cape Peninsular Lighting Co., Central Power Station, Claremont, Cape Colony, South Africa.

Reece, Eardley B., The Treasury, Accra, Gold Coast Colony, West Africa.

Stilwell, J. B. L., 42, Pall Mall, S.W.

The paper read was—

PHYSICAL AND MENTAL DEGENERATION.

By Robert Jones,
M.D., B.S., M.R.C.P., F.R.C.S.

When I accepted the invitation to speak upon this subject before your Society I fully felt the limitations of my experience, but inasmuch as my professional career for over quarter of a century has been spent among the poorer classes—the industrial population, whose work produces the arts, the manufactures, and the commerce of this country; as also the fact that my experience has coincided mainly with the period during which our present educational system—now about to be changed—has been in vogue; and the further fact that my practice has brought me into contact daily with those who from stress, heredity, or environment

have "gone to the wall"—I trust that a review of this experience may commend itself to your consideration. A truthful record of our failures as well as our successes should convey to us some significant and emphatic warning, and thus enable us not only to avoid a national peril, through a reduction of the strength, vitality, and vigour of our people, but should also help slowly to perfect that complex condition which we call civilisation, and so be able to render human society more stable and more efficient.

Convinced as I am of the existence of a deterioration among the lower classes and their issue—a view which has been especially emphasised during the last few weeks in the public Press, by persons of authority and ability, I feel, that however inadequate an exponent I may prove to be in regard to this question, which has not only its medical, but also its social, economic, and even its political and philosophical aspects—I am comforted by the belief that it is impossible for any one person to speak with a comprehensive authority upon its many widespread causes, and I trust that the Council of your Society may not be altogether exempt from the rebuke which some of its members may consider to be mine for my presumption and temerity in attempting so great a task.

This is an age of statistics, and the numerical argument now holds the field against all comers. I may point out, however, that only since the Jubilee of the Royal Statistical Society of London, in 1885, have statistics, or the "laws of large numbers," been acknowledged as a factor in the progress of science, and this was the first occasion, in this country at any rate, upon which the *technique* of statistical investigation was especially discussed, although there was a tacit acknowledgment of its usefulness in regard to administration and finance. There has been a strong prejudice against the use of arithmetic as a coadjutor in the investigation of moral questions, and only quite recently has the ignorant hostility abated with which many people—even among the educated classes—regarded statistical inquiries into the nature of human society as bearing upon the comfort and happiness of man. While we must admit that statistics do not supply the whole of the facts in regard to the physical, mental, and moral conditions of the people, we cannot but regret that at the present day we are without any definite arithmetical basis to express the measure of a condition which, although alarming, and the caus of so much uneasiness, is yet accepted as condition existing in certain strata of th population. I should like here to acknow ledge our indebtedness to the great work Dr. Warner, who examined over 100,0 children, to Dr. Bowditch, of America, D Cheatle, Dr. Hirsch, and others who hav rendered so much assistance in this directio No one who has had experience among th insane, can, for one moment, doubt that the is a degeneration consequent upon evolutio and the term *degeneration* has, for this reaso been preferred to deterioration in the title this paper. That degeneration is more mark than it was twenty-five years ago, is an opini shared by others as well as myself, and o object at the present time is the formation of sound public opinion in regard to it.

In this paper the normal is considered to the average between two extremes, viz., th physically impaired and the mentally unstab on the one hand, and the thoughtful, we balanced brain worker on the other. Tho who fall below the normal standard but a above the extreme degenerates, constitute th class described as suffering from deterioratio With regard to the latter I shall, in great pa draw from the experience of others, but as m remarks deal both with mental and physic characteristics, I desire to lay stress upon th intimate relationship between mental a neural processes. The body is the organ the mind as well as the instrument throug which it works. We cannot move witho muscles, nor see and hear without eyes a ears.

What the actual relation of nervous process to conscious processes may be we are unab at present to determine. There is no eviden of the creation of material energy by conscio processes, and we are unable to explain su by the law of the conservation of energy, there is no common factor in the comparis of a nervous process and a correlated conscio process. Neither can we say that matt causally determines consciousness, for t process of consciousness cannot be resolv or analyzed into such processes as t physical and chemical changes which ta place in nerve cells. The materialistic theo as has been said, destroys the "agency" the part of conscious beings, and no judgme could, on this theory, ever be due to a train reasoning, a volition, or a motive—all wo be the fatalistic result of explosions in ne cells. We are thus thrown back upon a sta

ıent of fact, which, however, is not an expla-ation of the phenomena, viz., that modifi-ations of consciousness emerge contempo-ıneously with a corresponding modification f nervous processes, and that the relation of ıind and body is a psycho-physical paral-lism. In order to have a healthy mind we ıust have a healthy body. All our experience ıpports this view, and the first stage in the eatment and cure of all forms of mental isorder aim at improving the bodily condition, r we know that an impairment of the nervous nits in the cerebral grey mantle of the brain accompanied by a loss of power over the ody, and an impairment in the quality of the ıind.

We know further that an injury in the left alf of the brain, involving an area exactly escribed by Broca, gives rise to paralysis of ıe right half of the body, with loss of speech. destruction of other regions of the brain pro-uces word-deafness, and although sounds are eard there is no understanding of the mean-ıg of words. Destruction of certain other gions produces word-blindness, and although onversation is possible, there is inability to ad aloud written or printed words. More-ver, as the vertebrates rise in the zoological cale, and a series of brains are examined, ıere is an increased complexity of structure, ntil in man the highest degree is reached. egeneration of this complex structure is ccompanied by a degeneration in the parts ot ıe body whose function is simultaneously ffected. Physical diseases thus have their ıental accompaniments, and experience proves us that there are certain bodily indications mental degeneration. These indications re termed stigmata, or marks, and as custom amps itself upon the body, possibly of all arts which take the expression of the custom habit of the mind within, the physiognomy is ıe most convincing, for like the barometer—hich is an indication of the state of the eather—the facial expression tends most to ıow the mental state, and although there are me who can counterfeit their passions, we e generally able to diagnose many forms of ıental disorder from the facial appearance one, we can all tell wrath from mildness, bene-lence from malevolence, joy from fear, and casionally age from youth. All those rsons who are thrown into much contact ith human nature, appreciate the value of ıe physiognomy as an index to character and nduct. Nature sometimes is pleased to ıveil herself in one single factor, and the eyes alone—probably a truer index to the brain than the mouth—with their colour, delicacy, clearness and finish may afford us the decisive clue, and serve to us as the pole-star of the physiognomy. We know the inconstancy expressed in the roving eye, which looks upon everything and sees nothing. The eyes may be too near together, imparting a sinister expression probably accompanied by delusions of suspicion ; or too far apart—as in animals—indicating mental poverty and inferiority. They may also be either prominent or sunken. Again the eyebrows may meet, portraying brutality and physical strength ; or passion, anger, and ferocity—which the older physicians and physiognomists considered to be the inheritance of wolf-like or swine-like attributes. There may also be such eye abnormalities as are indicated by albinism, congenital cataracts, strabismus, ptosis, or astigmatism. Further features of degeneracy may be found in the ears—the volutes of the hnman capital—in regard to which Mr. A. C. Plowden (whilst acknowledging that much of the interest of his work as a magistrate lay in a close scrutiny of the human countenance) states that he made a mental note if a prisoner had abnormal ears, for he says they were often significant. In congenital degenerates the ears may either be asymmetrical, or planted low down, or far back, or set at an angle, they may be small, and symbolise effeminacy, petty anxiety, worry, or deficient mental develop-ment, or they may be coarse and large, and indicate a lack of mental elevation and fine feeling. From time immemorial the ears have been sculptured to indicate various physio-logical and psychological expressions. Her-cules has massive ears, Diana small and ener-getic ones. Jupiter has noble ears, and Venus has delicate and well folded ones. Silenus again has sensual ears, and dancing fauns, elfs, goblins, and satyrs are represented with large, flat, badly folded and sharply pointed ears of a strictly animal type and expression.

The presence of a lobe to the ear is a dis-tinctly human characteristic and a sign of degeneracy is stated to be a tubercle on the helix—referred to and pictured by Darwin. Other bodily stigmats are excessive or diminished stature, chest malformation, rickets, spinal curvature, skin pigmentation ; hairy development, its absence, or a deficiency in pigment, misplaced teeth ; cleft, highly arched or narrow palates, convulsions, tics or tremors, speech or gait defects, super-numerary or deficient fingers or toes, and cranial de-

formities. When these occur singly they are not a mark of special significance. It is not one sign but the complex of many and well marked stigmata in the same person which warrants a right judgment, and affords cumulative evidence of a degenerative taint.

Although we like the brightness of the eye which indicates vivacity, the symmetry of the lips, which shows equanimity and composure, and the shapely well convoluted ears, which indicate refinement and sensibility, yet too great stress must not be laid upon the so-called stigmata of degeneration, unless the structural anomaly impairs the functional activity of the organ affected, for men of vigorous minds and great talent may possess marked asymmetry of heads and faces, whilst imbeciles, on the other hand, may exhibit perfect symmetry and even beauty.

I have now shown a few of these stigmata, which are to be met with in a large proportion of the cases admitted into Claybury Asylum. Some of these are, however, met with among sane persons, but in lesser degrees and lower proportion. It is a significant fact that, out of 1,000 consecutive male cases received into the above-named asylum—mostly from East-end districts—143 between the ages of 15 and 25 years inclusive, were greatly below the standard in height and weight, when compared with the averages in the general population at the same ages. I am aware that the so-called standard for height and weight must vary in different countries, and even in different districts of the same country, as it also does for different classes. I know also it is asserted that the stature of the upper classes has increased, but I am not concerned with this. I know this is not so among the poorer population of our large towns, and this is the bedrock which serves as the material actually available for the recruitment of the naval and military forces of the Crown. I have prepared a table giving the exact height and weight of the cases referred to, who are typical of their class, and this points to the existence of a physical degeneration among a large number of the population, and for which some cause or causes should be found.

I show you now a picture of seven children, all seven years of age, from the pitiful "waifs and strays" class, ill cared for, ragged, and shoeless, but their tatters have been laid aside. They have just been received from the grimy slums of East London into Dr. Barnardo's Village Home at Barking Side for 1,000 girls, where so much is done by a new environment to contend against faulty heredity. In most of these cases the home life had been unspeakably wretched. Dire poverty, drunkenness and crime, are familiar to most of them. I have taken the opportunity of examining some of these slum children soon after their arrival at Dr. Barnardo's Home, and found a high proportion with enlarged glands, narrow palates, or adenoid throats, some with squints, others with ear discharges and sluggish, languid circulations. I also show you pictures of boys and girls of the same age from a school for 2,000 children in the East end of London. The head mistress informed me that some of the small boys sent there were half starved, and that she was feeding them; also, that they were so overcrowded at home, that from six to eight of them all lived in one room. I found ample confirmation of ill-health. They had glandular swellings, anæmia, ill-shaped palates, and defective teeth. As to this latter sign of deterioration, Talbot, Kingsley, and others have urged the necessity of attending to the permanent teeth of growing children. Bad teeth makes a difference to the adult between robustness and the many enervating ailments of dyspeptic ill-health. The teeth of school children should be a matter for more attention than they now get. I give you, as a contrast boys and girls of the same age from a country side school in Essex (Abridge), who also came from poor homes, whose poverty—which has many grades, and is in general the result of improvidence—is consistent with respectability. Their height and weight are compared, and are significant. In the matter of dress of these country children there is nothing to be desired. The children are cleanly in person, and neat in attire. As an accurate exhaustive, and permanent work of reference in regard to the physique of the school children the statistics of Drs. Matthew Hay and Leslie Mackenzie in Aberdeen and Edinburgh, for the Royal Commission on Physical Training (Scotland) will always remain a valuable authoritative record. It is what we need for London and other large towns, and what we ought to have. It cannot be expected that private investigations should in any way be as complete as is the monumental record. The revelations conveyed by the inquiries are absolutely dreadful, as showing an amount of ill-health resulting from unhealthy homes, inadequate clothing, and underfeeding, amounting almost to semi-starvation in young people of school age, which was never anticipated, nor even suspected. Dr. Leslie Mackenzie, who examined childre

the North Canongate School in Edin-rgh, found more than half of them d eyes so optically imperfect as to inter-e with their daily tasks. Hearing was ective in 40 per cent., and nearly all had eases of the nose or throat. Dr. David nnox summarises his anthropometric ex-iences in regard to children in the town of ındee, between 12 and 13 years of age. ıeir average height was 53·14 inches, against ·72 of the general population at the same e. Many of them were insufficiently fed and ıthed, they had bad teeth, and suffered from ligestion and bloodlessness. They had ıall chests, which indicated obstruction in e respiratory passages, or a want of fresh air d malnutrition. Dr. Lennox further states ıt the proportion per cent. of Dundee recruits the regular army rejected for defective de-lopmeut amounted to 11·4 against 9·06 for e whole country. Dr. Hall, of Headingly, ar Leeds, has published most instructive ıtistics in regard to the comparative physique Jew and Gentile children from the poorest ıard School districts of Leeds. He found the ebrew children much better developed than e Gentiles born and bred in the same slum strict. (By his kindness I am permitted to ow comparative pictures of these children d I am pleased to say that he is here him-f.) The Jews were superior in height and ight, much less rickety, und had better eth than the other children living in the me working-class districts. This result is e to the fact that in the case of Jewish rents greater efforts are made to nourish d nurse the children. They are fed more tionally, and watched more carefully and osely than is the case with other poor others. It is said by one of the medical icers that in Sheffield only one in eight of e infants is brought up at the breast, the st are bottle-fed, with consequent ill-health, idenced by rickets, diarrhœa, snd a high ant mortality. There is further a deplorable reading of this practice of artificial feeding, ıich, if not the chief cause of the high infant ortality, leaves the survivors to continue the uggle for existence with constitutions riously weakened and impaired. Whilst on this point I might mention the success, t only by direct benefit to the children, but so by the educational value to the mothers— providing clean milk in regular and uniform-ses. In one place (Leith) the superintendent the milk-shop is a qualified nurse, who has ict injunctions to refuse milk for infants who may still be fed on the breast. The greatest credit is due to Drs. Robertson, McCleary, and Hope, of Leith, Battersea, and Liverpool respectively, as also to the municipalities of these places and of St. Helens and Ashton-under-Lyne, for directing attention and taking steps to the saving of infant life. Many mothers, even among the poorer classes, seem to have lost the recognition for the dignity and responsibilities of a mother's life. There is an increasing devotion to pleasure among married women of the lower classes, and it is a serious assertion that they look with com-placency upon the conjunction of an increased marriage and a diminishing birth-rate. This self-indulgence carries with it a blunting of the sense of pity and a tendency to undis-cipline of temper. That this is so is evidenced by a comparison of the birth and marriage rates for England and Wales in the fourth quarter of 1903, just published. The birth-rate was 27·3 annually per 1,000 of the population, as against the mean rate of 28·5 for the corresponding quarters in the previous ten years, showing a diminution of nearly 1 per 1,000. The marriage-rate during the third quarter of 1903—which is the last published one—was equal to an annual rate of 17·1 persons per 1,000 of the estimated popu-lation, against an average rate of 16·8 per 1,000 in the third quarters of the ten years, 1893-1902. For London during the same period the marriage-rate was 20·4, considerably higher, showing how lightly people consider and how readily they undertake matrimonial obligations. There is certainly among the poor a vast amount of ignorance in regard to the upbringing of children and the common duties of motherhood. In one district of London, during an average period of ten years there has been an annual infantile mortality during the first year of life amounting to 226 infants per 1,000 births. It is not so high in the six next large English towns as in this district of London. Of the total deaths in the last quarter of 1903, over 25 per cent. were those of infants under one year. From information I have obtained through the Regis-trar-General, the rate of infant mortality under one year of age per 1,000 births was higher in 1902 than it was in 1881. This excessive infant mortality has, however, coincided with a lower general death-rate during the last quarter of 1903, than has been the average for ten preceding and corresponding quarters; but although a welcome indication of less ill-health and consequent expense, yet it must

not be assumed that a low death-rate is an indication of national improvement, for degeneration and longevity may proceed *pari passu*. Never in the history of the insane have more so-called senile cases of insanity—some of them due to the natural involution of old age—been brought into asylums, where they live on at the public expense, ending their days unnaturally separated from their kith and kin. I do not say they were brought unnecessarily into the asylum, on the contrary it was imperative for their own care and the safety of others. This breakdown was doubtless partially caused by the hurry, the rush and pressure of the age, the intolerance of affliction, and the growing egotism of men and women, who will not suffer their pleasures to be curtailed. This unnatural activity of the age is responsible for much overstrain, and high arterial tension, which is one of the most fertile causes of premature senility. There are forms of heart disease now which were unknown in the early years of the last century. Cardiac and brain sedatives are much more common, and nerve tonics in the shape of phosphorus, arsenic, and strychnia are more frequent prescriptions. So common is headache now that the cheap daily Press advocate headache powders in every issue, and almost every lttle village shop stocks them. I can point to not one but to many cases of men and women who are total wrecks and completely "played out" at 55! and yet it seems to be a matter of surprise that more old people are decadent and require asylum care, whilst the cry goes out that our asylums, or our Poor-law, or our medical clinics want reforming. I believe in money wisely spent upon scientific investigation, but I believe more in the prevention of insanity than in its cure. For the whole of the County of London during the ten years 1893-1902, there were 4,478 persons (2,476 males and 2,002 females) over 65 years of age brought into asylums, being a proportion for London of 16·2 per cent. males and 11·3 per cent. females of the total admissions of all ages, a higher proportion than that throughout England and Wales, viz., 10·47 (males 10·03, females 10·79), which includes urban and rural districts. The Lunacy Commissioners, in their last report, call attention to the increase of senile cases in asylums, and state that whereas, in the quinquennium 1897-1901, the proportion per 10,000 of the population was 15·6 for males and 14·0 for females; ten years ago the proportion for the quinquennium 1888-1892 was 11·6 for males and 10·2 for females.

The revolt against domestic service amon the lower classes is a serious reflection. I reflects in part upon our system of education as it also does upon the love of pleasure whicl dominates every class. I have repeatedly see young women who seek situations as nurses i the asylum, and are looked upon as th triumphs of our educational system, but wh have not the faintest knowledge of domesti duties, and although professing it, not muc more of piano playing. I have also unde treatment as patients many from the class c factory girls who teem in East London; all c these are practically ignorant in regard t household economy. Some of this class coul not lay a fire and could not do their ow washing, others, it is no exaggeration to say hardly knew one end of the needle from th other. Although they marry hurriedly—an nature, as Mr. H. G. Wells says, is a remorse less coupler, and she remorselessly destroys—they are absolutely incapable of bringin up children, or clothing them, or c cooking simple food for home consumptior preferring to fall back on the tinned enor mities of local provision stores, the cor tents of which are, in many cases, eithe sophisticated with harmful preservatives suc as formal, boric, or salicylic acid—the latt closely allied chemically to carbolic aci which is a poison unless much diluted—c they are prepared under insanitary cond tions, the proteid or albuminous food unde going chemical decomposition, and formin ptomaines which resemble the poisonous veg table alkaloids, thus becoming unfit for huma consumption. The offspring of such mothers have myself seen. They are attenuated, neuroti and sickly, and they contribute to the ranks the maimed, the deformed, and the degenerat I venture to assert that the cause of the chi dren is a national asset which we can ill affo to neglect, for the success of a nation depen upon the physical and mental health ar strength of its citizens into whom the childr grow. Dr. Farquharson has painted sad pi tures of them sitting—under the direction the Educational Department—crowded forms for weary hours, ill-clad and ill-fe Surely a child is born to the State as well as the home, and every child has a natural rig to be fed. Children cannot themselves ca attention to their sufferings. The respons bility of their care rests, in the first instanc with the parent or natural guardian, and it the duty of the State to see that this obligati is discharged or enforced when the natu

parent has failed, or neglected his duties in this respect. This doctrine has received the sanction of long usage, and forms the basis of our existing Poor-law system.

In regard to our system of education, one is inclined to question at times whether it has come up to our expectations, and fulfilled its functions. Although we have a body of teachers with enlightened views of their profession who are fully alive to the responsibilities of their great calling and to whom all of us are greatly indebted, yet I fear the answer is not as satisfactory as might be wished. Children are treated too much together—too mnch *en bloc*, and the weakest must suffer. The old idea of education was putting something into the child. Matthew Arnold said that "education should teach people to do the right thing in the right way and at the right time." We have now learnt that education should be so directed as to develop the full man, and that it should draw something out of the natural capacity of the child, so as to improve his condition in life, subordinating his life to the intellectual and moral well being of the many, and we have further learnt that education is of small service unless it is directed with this end in view to a healthy race. The new Education Bill correctly aims that each local authority should determine what should be taught in each district, and that children should be fitted to come to a commonsense conclusion upon a practical question. It has been stated that people do not now think for themselves and that men have not sufficient capacity to be able to concentrate their thoughts upon any difficult mental task for any considerable time, and that work never took it out of people as it does to-day. The Poet Laureate the other day stated his conviction that we were less intellectual and less spiritual than our ancestors, that material prosperity was the cosmopolitan creed and religion of the time, and that wealth was the very divinity of the age. Ours is certainly less a thinking than a reading age, and boys are often taught to read only to use their acquisition to get the sporting tips. Fifty years ago there was much less reading than to-day, but but no one can say there was less intelligence. Our ancestors certainly read less than we do, but their reading was of a more solid and enduring character than is ours. The scarcity of books and the comparative rarity of journals induced readers to master what they read, with the result that they absorbed nourishing intellectual food. A superficial attention to an ill-digested course of reading, dulls and benumbs the intellect. Some of the journals of to-day have to be helped off by prizes, lotteries, treasure hunting, and all manner of tricks and dodges which appeal only to the weak and the degenerate. I have had not one, but several youths, whose insanity was distinctly traceable to the injurious tone of the literature they indulged in. It is also stated by those qualified to give an opinion, that the steeping of our youth in the prurient, exciting, and unreal literature of to-day has been the principal cause of neglected household duties, unhappy homes, and a large percentage of crime, as is often testified in the summing up of our various stipendiaries. I am of opinion that instruction in cooking, domestic economy, and household duties, should be the primary consideration of the educational authorities as regards girls, and that some standard of efficiency should be required in the place of the "shop window elegancies," as I have elsewhere ventured to call them, of piano playing and drawing. The ornamental attainments should come after, and not precede the essentials. The description of the domestic economy department of the Battersea Polytechnic, opened on February 24th, by the Prince and Princess of Wales, in which is provided a laundry demonstration room, housewifery, kitchen, scullery, larder, and bedroom, needlework and dressmaking rooms, shows how this question has now come to command attention.

I consider domestic service to be the only real training which can enable girls to become good wives and mothers, and its unpopularity is indirectly responsible for the high infant mortality already referred to, as also for the impairment of physique and the perversion of natural development which I have portrayed, and which is, without doubt, affecting a stratum of the present generation by the improper rearing of children. This scepticism as to education is not limited to that received by the lower classes, it has invaded that given in our public schools as well as our Universities, "the home of lost causes and impossible beliefs." This doubt of the efficiency of our system proceeds from two opposite standpoints, the one from the mental, in regard to the over-pressure of a weakened physique, the other from the engrossing devotion to sport without serious attention to intellectual pursuits, and it is in the main, in my opinion, a sign of life and of reawakened interest in the two necessary

aspects of mind and matter, a relationship which is insisted upon as the basis of this paper.

As further evidence of degeneration may be considered the great and serious question of insanity. In the whole range of medical science there is no more painfully interesting subject.

It is the debatable land of the imagination which presents many subordidate varieties of its wanderings — the dream of the poet, the fable of the mythologist, and the fiction of the romancer being woven with its threads.

Insanity, in the excursions of mania, with its fancied consciousness of unlimited power, its self-satisfaction — that abundant source of mental delight—bestows upon its victim feelings of bliss much more exalted than fall to the lot of sober reason; but insanity in the self-condemnation and the misery of melancholia inflicts far severer pangs than can be produced by the most extraordinary anxiety and the most acute bodily pain. What is it that constitutes insanity? It is not the presence alone of delusions or hallucinations. There are many persons in daily life who fulfil all their duties and obligations to society and themselves, and who yet suffer from hallucinations. Although a perversion of the mental functions, insanity is not exclusively an intellectual disorder, for persons gifted with high intelligence may fail to respond to ordinary motives and become so defective in their habits as to be socially unfit to mix in the world. Again, the distribution of the mental faculties may be so uneven, and mental endowment may be so unbalanced, that their possessors are unfit to be at large. There are many persons incarcerated in asylums in whom there are merely exaggerations of normal tendencies, fluctuations of the mental faculties which may be described as excessive, or just beyond the normal limits, and which render these persons unstable, untrustworthy, and even dangerous, yet there is hardly, if any, loss of mind. It is only too well known that there are imperceptible gradations, as well as abrupt transitions between health—which is the easy, harmonious and unconscious performance of the organic functions—and disease, and there is no definite line of demarcation between sanity and insanity.

So far as any trustworthy information is to be had, it appears that insanity increases as man departs from the savage and semi-civilised state and approaches the highest civilisation. In primitive states of society an among uncivilised races insanity is rare, th chief form being associated with the taking c drugs, corresponding to the insanities of civili sation, such as those resulting from alcohol ether, cocaine, and morphia, which in th main are temporarily curable, provided th cause is removed. Among primitive peopl insanity which ends in dementia is rare, an dementia itself is uncommon, in fact, it is onl when we come to the higher civilisation tha the more serious and higher forms of insanit are met with. As to the causation of insanit it is certain that alcohol is one of the mos potent causes. Taken to lull and to veil th little worries, the small pains, and the genera mental disturbance of whole classes, it is give in the last annual report of the Lunacy Com missioners to the Lord Chancellor as the sug gested cause of a fifth of all insanity occurrin in men, and more than half this proportion i women. If taken as a contributory cause c in combination with others, the percentag would undoubtedly be much higher, and suc a cause calls loudly for definite action. believe that at the present time no less tha 11,000 males and 6,000 females are mentall decrepit through the effects of alcohol.*

During the time that the London Count Council asylum at Claybury has been opene 1893 to 1904, a period of which I have direc experience as medical officer, 9,544 patient (4,251 males and 5,293 females) have bee admitted, of whom 965 males and 699 female —a proportion of 22·7 per cent. of the male and 13·1 per cent. of the females—were def nitely ascertained to owe their insanity t drink. This means compulsory detention an support through their own acts at the rat payers' expense. Through a loss of inhibitio alcohol contributes indirectly to other sensuo excesses, all deleterious to nerve centres; o in particular, viz., the contagion which is th cause of general paralysis of the insane, disease which is incurable and yet preventib —a form of insanity to which, above all other our service men, soldiers and sailors, are mo prone. Many of the patients admitted throug drink were married, and had families d pendent upon them, and the misery and cruel of neglect—apart from any ante-natal caus (such as the transmitted reduction of vitali

* During the last ten years 1893-1902, inclusive, 35,9 persons (16,350 males and 19,560 females) have been admitt into all the London County asylums. In the cases of 5,7 of these persons (3,497 males and 2,230 females) insanity w assigned to drink as a cause; a proportion of 21 per ce among the men and 11 per cent. among the women.

lue to alcohol) in the parents induces a feebleness in the offspring, which it is impossible orrectly to estimate. Carefully compiled tatistics give 56 per cent. of the children of lrunken mothers as dying before the age of wo years, against 26 per cent. (a very high nortality) among the general population.)rink involves an enormous loss to the community, through destroying the productiveness of the skilled craftsman. Many of the men brought into the asylum are of this class, and are at their best age, viz., thirty-five to forty, and, curious to relate, during 1903 no less than 50 per cent. of the men, and 56 per cent. of the women (where this could be ascertained) were country born, showing that their town environment—to say the least—was not favourable to heir self-restraint, and that it is not alone he degenerate who falls a victim to drink. Although alcohol itself is a certain cause of deterioration. I admit that there are many factors, such as competition, insecurity of trade, insanitary surroundings, poverty, and, in some cases, want and starvaion, which may have induced alcoholism. Of this, in my mind, there is no possible doubt. Cases of alcoholic insanity are also more liable o phthisis than other varieties, possibly owing o their susceptibility to the inimical effects of cold and exposure. The statistics of life insurance offices are an interesting study, and serve o point a strong moral in regard to degeneraion from this cause.

It is not too much to say that there are other forms of injurious beverages besides alcohol. The evidence of Miss Ellis with regard to tea-drinking among Welsh quarrymen, published in a report of he Departmental Committee (1895) upon Merionethshire State Mines, is supported by he medical men practising in the district. Both tea and coffee drinking can be carried o excess, and instruction as to healthy iving should be imparted to all children. In the first place, however, the teachers hemselves should be acquainted with elementary hygiene. In the wake of drink comes tobacco-smoking, upon which medical opinion s unanimous that, for the young and those of unformed physique, it is inadmissible and pernicious. Personally, I have known it stated by the relatives and friends of some of the inmates in the asylum, to have been the exciting cause of the patient's mental breakdown, but I am unable to state that any definite form of insanity is directly caused by it in this country. I am certain, however, from experience, that the inhalation of cigarette smoke directly induces functional palpitation, dyspepsia, and an inaptitude for physical and mental energy. It probably creates thirst and may thus favour drinking habits. It is interesting to note that 44 of the 53 United States of America have penalised juvenile tobacco smoking, prohibiting its use under ages varying from 14 to 21 years, or an average age of $17\frac{1}{2}$ years, which is higher than that suggested (viz., 16 years of age) by some of the so-called anti-tobacco societies in our own country.

In every case of insanity there has been a breaking-point at which stress of some kind has acted as a proximate and enciting cause upon an organism predisposed to break down. This great predisposition is determined in the main by a faulty heredity and an unsuitable environment. In the present day, more than in any previous period, does an inherited instability of organisation make itself evident by a breakdown at one of the physiological crises of life, and a hereditary tendency to insanity is ascertained to occur in more than one-third of all cases brought into asylums. These figures are derived from the collective investigations of medical officers in all the public and private asylums of this country. In regard to the relative influence of heredity and environment, Karl Pearson states from careful and elaborate researches that physical and psychical character are equally inherited, both in the same manner and with the same intensity. He asserts that children inherit in this way their parents' consciousness, shyness, and ability, even as they inherit their stature, form, and span. Those who have had large experience with the insane, and who are in the habit of seeing their relatives, know how true this is, and not only do animals but plants also tend to resemble their progenitors, for when the protoplasm grows under similar conditions, the tendency is to a symmetrical repetition of equivalent parts, and the more similar the conditions the more does the resemblance tend to become complete. There is overwhelming evidence that the environment modifies growth, as we know to be the case in the production of variations, which shows that there must be some latent power in the cell itself, and, in my opinion, this modified growth may be transmitted. There is no proof that each cell in the germ plasm is predestined unalterably for a particular rôle on a predetermined plan. The accumulated evidence of clinical experience is against this, and I believe

a new and favourable environment to be the strongest force both to modify and to control the defects of a vicious heredity. I believe that we can alter the physical and psychical characters through the influence of the environment—and school teachers acquainted with the family history of a child may be able to guard against the bad effects of a family heredity—otherwise where does the reformer, the sociologist, and the educationalist come n? It is the logical basis of all the ethics. I know that it is urged by Weismann and others that one portion of the germ plasm lies dormant in the body of the host, giving rise to the continuity of the germ plasm from generation to generation, and that the other portion becomes the new organism, and I am also aware that the deductions of morphology, laboratory experiments, and microscopical observations are against the transmission of acquired characteristics, but the practical man does not coincide with this view, and the experience of the philanthropists does not support it Look at the picture from Dr. Barnardo's Home of the girls of 14 years of age, who for years have been clothed, nourished, and trained mentally and physically in accordance with the laws of health, and yet who were received as deteriorated specimens from the waifs and strays of the slums of East London. Compare their height and weight with others. Dr. Barnardo himself says in regard to drink that his general experience tends to press one particula line of thought upon him, viz., that wher drinking had begun with the parents of child prior to its birth, and where suc drinking had become habitual and had bee long continued, the effects, seen in man ways in the child's organism, were n necessarily permanent, and if the child i placed early enough in a healthy enviror ment, the inherited evil tendencies and effect appear to diminish year by year. Where, how ever, drinking began two or three generation back with the grandparents or great grand parents, then the character of the evils wa much more permanent, powerful, and de teriorating.

COMPARATIVE WEIGHT AND HEIGHT TABLE.—COUNTRY *versus* TOWN.

Weight.						Height.					
Boys.			Girls.			Boys.			Girls.		
	Age	lbs.		Age	lbs.		Age	ft. in.		Age	ft. in.
Lambourne School	7	55·3	Lambourne	7	52·1	Lambourne	7	3·10¾	Lambourne	7	3·9½
Dr. Hirsch (Tables)			Dr. Hirsch (1)	,,	44·9				East London ...	,,	3·7¾
(No. 2)	,,	47	Do. (2)	,,	41·5	Dr. Hirsch (1) ...	,,	3·8			
Do. (No. 1)	,,	46·9	Dr. Barnardo (Schl.)	,,	40·6				Dr. Hirsch (1) ...	,,	3·7
East London	,,	40·3	East London	,,	38·8	East London ...	,,	3·7¼	Dr. Barnardo ...	,,	3·4
Lambourne............	13 to 14	79·1	Dr. Barnardo	14	103·	Lambourne	13 to 14	4·7	Dr. Barnardo ...	14	5·0
Dr. Hirsch (1)		76·9	Lambourne	13 to 14	83·						
Do. (2)	,,	72·5	East London		81·	Dr. Hirsch (1) ...	,,	4·6	Lambourne	13 to 14	4·9½
			Dr. Hirsch (1)	,,	78·6				East London ...		4·9¼
East London	,,	69·7	Do. (2)	,,	74·9	East London......	,,	4·6	Dr. Hirsch (1) ...	,,	4·7

Look also at the pictures presented by D Hall's experiment at Leeds already referred to Look again at the statistics of Claybur Asylum where physical drill is applied to th women, and farm or workshop occupatior such as carpentering, wood-carving, tailor ing, shoemaking, painting, &c., is pro vided for the men, and where both sexe are fed upon a considered and fixed dietar scale. During 1903, 45 patients who recovere were detained from one to three months, 2 were detained from three to six months, 2 from six to nine months, and 21 from nine t 12 months. Those from 15 to 20 years of ag gained an average of 16½ lbs., those from 20 t 25 gained 17 lbs., and those from 25 to 3 years of age 12 lbs. A gain in weight ind

ates, as a very general rule, marked improvement in mental health as well as physique. cannot help thinking that too much is made f heredity and too little of environment. Vhilst upon this aspect I venture to call special ttention to the success, mentally and physically, which has attended the application of rill, or a methodical use of muscular exercise 1 the case of the female patients under my reatment. Besides improving the mind and trengthening the body, this exercise has a pecial educational value, for it connects nental and muscular processes, it quickens he senses, re-opens dormant paths in the nind, and, by engaging the attention, ensures more precise and ready re-action to outward timula. My colleague, Dr. Ewart, and myelf, can speak in the highest praise of Swedish lrill, as the system is called, as a corrective f neurotic heredity, and a valuable addition o the treatment of the insane. It places the iervous system in a more normal state of tenion, the whole mind, for the time, is absorbed n one task, and there is a pleasant reaction, lue to a new attainment. It has been witiessed by the Lunacy Commissioners, who ecommend its extension, and some pictures of t are shown here to-night for the first time. feel certain that physical culture is one of he greatest needs for our young people of o-day, and the matter is not too strongly irged in that invaluable report of the Commissioners appointed to investigate physical raining in Scotland, a report which it is not oo much to say should be in the hands of very teacher, as well as of every father of a amily.

There is an urgent need to fortify the inlividual against any hereditary predisposition o break down under the depressing effects of own life, which acts so detrimentally upon the oor. To this stratum—which is at the mercy f every economic fluctuation, and which is nost prone to insanity—town life brings lack f proper nutrition, overcrowding, with unsuitible hygienic and moral surroundings, poverty, nd crime—the latter an evil worse than overty, and one bearing a very intimate elation to insanity.

Overcrowding leads to many and various niseries, with personal discomforts which are iumiliating and demoralising to the grown-up, and are a source of moral contamination to their descendants, in whom they cause mental and bodily degeneration. In spite of the great efforts made to bring the poor into touch with the church, religion plays a very small part in their lives. The conclusions of Booth show how crowds of people have their happiness stifled by their environment in our own city, where an immense number of poor people live in small and badly ventilated apartments, with filth and squalor in their mean streets, and where their children become unhealthy, anæmic and stunted from the want of pure air and radiant light. As to the association of religion and cleanliness, we are encouraged to believe that cleanliness and godliness are characters essentially English, and that as a people we are the most godly and cleanly race upon whom the sun has the privilege of shining, but it is a rude shock to learn that the baths in the model dwellings are often used as receptacles for lumber. As to poverty there were in London, according to the census of 1891, no fewer than 174,500 tenements consisting of a single room, each giving shelter to families, varying from three to 12 persons, and there are over a million and a quarter of people whose wages for an average family of five does not exceed 21s. per week. In the first week of February, 1904, there were in London no less than 117,307 paupers, of whom 75,085 were indoor and 42,222 were out-door. This shows an increase of 1,191 upon the corresponding week of 1903, and of 6,641 over the corresponding week of 1902, and 10,367 over that of 1901, a greater proportion per 1,000 of the population than for the corresponding period of any year since 1875, showing a definite spreading of the dependence upon State assistance, and a decline in the effective strength of individual self-help and self-respect, which are the vital conditions of economic and social progress. There is one aspect of this class which is not to some without comfort, and that is their infertility. Mr. Alexander McDougall took careful records of the antecedents of paupers in Manchester for one year, and he only found 14 per cent. whose parents had also been in receipt of relief. I have further noticed this feature in regard to the insane; many, indeed I may say a fair proportion of married women in the asylum are childless, which seems to be a wise dispensation of Providence, that the unfit should not cumber the earth.

The food of the poor in cities is deficient in quality and quantity, and the cooking for this class in cities is stated, on good authority, to be worse than that of the same class in the country. It may be wondered how vegetables, fish, and milk can be fresh and digestible by the time they reach the poor of London, and

yet there is a constant stream of 80,000 persons annually migrating from the country to the towns, some of whom swell the ranks of the unemployed, and many of whom might be more healthily employed on the land. In 1876, 18 million quarters of wheat were produced at 50s. per quarter, whereas in 1901, only 6½ million quarters were produced at 28s., and the number of agricultural labourers have diminished in 20 years by 211,000, whereas, according to the increase of the population, there should have been an increase of 300,000!

The question of afforestation, reclaiming waste lands, and preventing sea encroachments at Imperial, county, or local cost, have received recent attention in another place. There is no doubt some need for simplification and a re-adjustment of the relationship between central and local authorities to remedy the grievous problem of the unemployed. It is estimated that there are 30,000 tramps "on the road," of whom one-third only are of the pauper class, and, in addition, 61,000 able-bodied paupers in England and Wales, and there is at present no uniformity in the treatment of this class. Many of these migrants from the country to the towns suffer in winter from cold, want of food and clothing, and in summer they endure a debilitating atmosphere from the reeking odours of dirt, decomposing garbage and noisome refuse. In cities where the population has to accommodate itself to the pressure of competition, the tension of mind is also more continuous, artificial desires multiply, unhealthy activities are created and ambition further forces the overworked brain, which sooner or later results in its complete breakdown. The wants of modern civilised life are many, but are rarely gratified, the eager hand reaches to grasp the prize which is plucked away by some other of the numerous competitors, and bitter disappointment is added to the nervous strain and mental overwork. There is no doubt that London, and *a fortiori*, other great cities, produce in the present day a tension of the nervous system as baneful as it is unnatural. One has only to look at the living maelstrom which pours into airless and sunless London offices, workshops, and factories every day from the suburbs to see the strained, eager, earnest, and inwardly pre-occupied faces of the people who are compelled to sacrifice their health and overstrung nerves in the cause of civilisation. As to mental degeneration, the earlier writers laid great stress upon a disturbance of the emotions or the habitual indulgence of the passions as physical causes of insanity. The over-much attention paid to personal longings and sensations by those who have too little occupation, or whose occupation is irrational and unhealthy. It has been demonstrated in the laboratory that the most exact nervous reaction takes place when the nerve circle is complete and in a state of healthy strain or tonus, and a life full of mental work and occupation is the most healthy. The tendency of many idle men and women of to-day is to gratify every passion, irrespective of the misery this may involve to those dependent upon them, and so much is this the case, that the Medico-Psychological Association, at the instigation of Dr. Mercier and others, considered, not long since, the advisability of calling for special legislation to deal with prodigals, spendthrifts, and persons guilty of gross self-indulgence. The judicial statistics (1903) show that certain kinds of law-breaking are on the increase, and, as indicating laxity of morals, the petitions for judicial separation and dissolution of marriage were higher than in any previous year. Commercial morality has declined; the business of the County Courts was the largest in any year since the Courts were established, and the number of debtors imprisoned was the largest yet recorded. This egotism, a characteristic of insanity, is fostered in the poorer classes by the poisoned environment of town life, and London alone is responsible for the production of over 70 insane persons per week. This number, high as it is, unfortunately is destined unrelentingly to increase, and it is not too much to say that the more highly developed a race becomes, the more cases of general paralysis and other lethal forms of insanity due to similar causes will occur.

The form of insanity named "dementia precox" was unknown a hundred years ago; indeed, it did not even find a place in the Lunacy Commissioners' Report to the Lord Chancellor until after 1878. It attacks prematurely our most promising and educated youth, it is practically incurable—the majority never recover from it—and it is, of all forms, the one caused by overstrain, and the mental rather than the manual worker is subject to its ravages. A quarter of a century ago the type of insanity was different from that of to-day. There is now an increased tendency to melancholia, which is less recoverable than the form characterised by excitement and called mania, and it is probably a deeper reduction of nerve elements than occurs in mania. Melancholia

as shown a considerable rise among the lucated and the private or paying class of the isane, and I am stating a fact and not an pinion when I say that recovery may be comlete after a sharp attack of mania, whereas nis is rarely the case after melancholia—pecially in the male sex. As to the general covery rate, that of the last year recorded by ne Lunacy Commissioners, 1902, shows an ctual decrease when compared with 1877, hich is twenty-five years ago.

As to the increase of physical degeneration, nere is a marked increase, within the last uarter of a century, in deaths from cancer nd nervous diseases. The former has increased 231·9 per million persons, and the itter, 239·3. As to mental degeneration, on anuary 1st, 1859, when the number of lunatics as first officially registered, the proportion of ne insane to the general population was 1 to 36. To-day the proportion is over 1 to 293, nd a rise has been noticed in "first attacks" r occurring insanity. Moreover, the practice f alienist physicians to-day reports more eak-minded and backward children as being cognised among the poor. In London to-ay these number 1 to every 182 healthy hildren. There is also a considerable increase borderland insanity, and there is more of iental instability which scarcely amounts to ctual insanity.

There is, further, also a larger proportion of ases which exhibit what is called "psychic ouble," cases which are not included in fficial records and which are outside statistics, ut which with different exciting causes may t any time add to and become the registered isane, more especially at one or other of the hysiological crisis, such as puberty, childirth, or the climacteric age. There is a difficulty on the part of people to grow old physiogically. Possibly, indeed very probably, the igh pressure at which we are living, and the ecessary sub-division of labour have evolved very complicated mental mechanism with very possibility therefore of getting out of rder in a manner unknown to a former eneration. Mental evolution means greater ihibition or the power to say "no" and the ent-up energies of our day are fewer and f less moment than in primitive times when ney found a more ready exit through muscular xercises.

Conclusion.

Although I do not deny that improvements ave taken place during the present generation through special legislation for the protection of adult and child life, as also for the better condition of the town-dweller, much yet remains to be done. We must, however, advance carefully and even slowly in regard to restrictive legislation, for such enactments should hold the balance equally between protecting the workman on the one hand and promoting the industry on the other, otherwise they work mischief.

With regard to the public health: in London, insanitary areas have to some extent been removed, open spaces have been increased and extended, and model dwellings for the working class have been erected, yet these boasted improvements are merely as a drop in the ocean, and there is without doubt a deplorable amount of ill-health existing among the very poor. There are many who are battling against tubercle, rheumatism and infection, the ravages of alcohol, contagious diseases, and crime. There is among the poorer classes of London and other large towns such a marked mal-nutrition from the want of light and air, through insufficient and improper dietary, as to be a disgrace to our humanity, and among a considerable number of the children attending schools there is an amount of bodily deficiency and a latent degree of disease which saddens a medical expert, and which must render the sufferers absolutely unfit for the struggle of life. At present we have no measure of what this may be and the first requisite is to establish a standard to be a basis for further inquiry as was done in the Scotch Commission. We shall then know the measure of overpressure and the amount of departure from the normal. This is a matter which must be of moment to every class of society and is of high importance to the nation. Teachers are unable to estimate the full amount of this deterioration, and up to the present it is only known in vague general terms. Teachers in conjunction with medical experts can give us the information and the investigation should be pressed upon the Government. There must be an awakening of the public conscience in regard to the elementary laws of health in so far as they concern the proper use of air and efficient ventilation, food, as to purity and cooking, and drink, as to its moderation. Mothers should have been taught in their schools, as children, the necessity for personal cleanliness, the value of and the care for their teeth, the elements of feeding and drinking with regard to temperance, and the importance of proper warm clothing. Our first attention

should be to the children—the great national asset of the State. The upbringing and feeding of children should be made familiar to every mother, and children should be properly and adequately fed, and they should have the joys of life brought before them. They should have plenty of little open air playgrounds, exclusively for themselves, with someone interested to organise their games, as in Germany. Between school time and manhood both sexes should receive as an essential teaching the elements of physical training also in the open air, and every effort should be made to encourage, by individual philanthropy, and, if possible, by State aid, such invaluable organisations as the Cadet Corps, Boys' Brigades, gymnasia and clubs with systematised athletic sports. Finally, no effort should be spared to realise Mr. Ebenezer Howard's great scheme of the migration of industries into the country. To summarise my recommendations I urge (1) a scheme for a health standard; (2) the better education of girls in the choice and cooking of food, and in all domestic duties; (3) improved physical training for both sexes; (4) greater inducements for people to remain on the land; (5) when migrating into the towns, better sanitary surroundings; (6) less alcohol and self-indulgence generally.

We do not want to "muddle through" with this great question which involves the physical as well as the intellectual power of our people, for at no time in the history of our country has the stress of ever-growing competition made a greater demand upon brain power for the scientific spirit in our workshops, in all branches of the executive, whether in the army, the navy, the higher commercial enterprises, or the universities. The effect of a Royal Commission has been likened to a high class funeral. It merely draws attention to the matter. It is true, I fear, that one of the greatest dangers threatening us to-day is a "mental listlessness" which prevents men from taking more than a passing interest in questions affecting the well-being of the community. There is reason, if not for alarm, at any rate for pause and reflection, and I hope for positive action upon this question. The Society of Arts, founded just 150 years ago for the advancement of British commerce among other objects, has done well and acted wisely in endeavouring to educate a public opinion by calling attention to a subject which deals with the strength, the vigour, and the vitality of our population, and upon which our very existence as a nation must depend.

DISCUSSION.

The CHAIRMAN said that as Dr. Jones had right stated, what was wanted was evidence such as th which medical experts had given before the Royal Co mission on Physical Training as the result of their e aminations of the Edinburgh schools, although su elaborate statistics as they gave would hardly be r quired in determining the question whether the sta dard had really deteriorated. It appeared to him th if they had some system by which the children in t elementary and secondary schools could be rough measured and notes made of their appearance a general health, there would be accumulated in t course of a few years some really satisfactory data which judgment could be formed as to how t nation was progressing in physical health. No o could doubt the very serious and lamentable co dition of a large proportion of the population; b whether the country was in a proportionate worse condition than it was thirty, or forty, fifty years ago was a question which we cou not possibly decide. On this matter we were guid by our own impressions, and he would venture to s that his own impressions were not the same as tho of Dr. Jones. He had had an experience of som forty years, including both London dispensary a hospital work, and he could not say that his ow observations led him to think that even the urb population were worse than they were at the begi ning of that period, though certainly their conditi called urgently for improvement. In the valua report to which the reader of the paper h alluded, Dr. Leslie Mackenzie showed contestibly that the degenerated or, he wou say, the impoverished and ill-nourished childr were especially found among the poorest elements the population, for instance, the majority of the ch dren in the Canongate school came from famil which lived in only one, two, or three rooms. seemed to him that the bed-rock of the question w poverty, and the inability of the poor to live und fairly hygienic conditions. It was very hard for h to believe that the physical condition of the nati was degenerating, for unless the progress of t whole of the Victorian era was a delusion a a myth, we were in a far better condition n than we were at the commencement of that e The people were now better housed, better f and better clothed, besides living under bet sanitary conditions. With regard to the reference Mr. Darwin's remark about the cartilage of the e in certain cases, he had always been under the i pression that what Darwin drew attention to, was t the projection on the concha of the ear, or the lit cartilage which some people had got, was a si of reversion to ancestral conditions, but he did n know that it was to be taken as a sign of degene tion. If it was a sign of reversion to the ancest type, those who possessed it ought to be physica

tronger, for he took it that our original ancestors /ere physically stronger than ourselves.

Dr. R. FARQUHARSON, M.P., said that he did not y any means think that Dr. Jones's conclusions were Jtopian. He thought that they were absolutely ractical views, which might be followed out to the dvantage of the community at large. One great omfort was that Dr. Jones had rather put aside the lea of heredity; that is to say, the idea that we were hysically deteriorating as a nation without any prac- ical reason for doing so. Dr. Jones had put down n very forcible and proper terms the great influence f environment on the deterioration of the human race. 'here seemed to be considerations in connection with ur modern civilisation which would lead one to uppose that a deterioration was going on. He was, n the whole, rather a pessimist in this matter, and e was not inclined to accept the optimistic view xpressed by even such a great authority as the Presi- lent of the College of Physicians. The very regrettable nigration of the country people into the towns was ringing about a deterioration. If by any means the ural population could be induced to remain on the oil and a better prospect be given to the agricultural ibourer, we might hope for a more healthy popu- ition, having good food and good air, and the errible competition which now went on in the towns or the bare necessaries of life, would be prevented. Vhat we wanted was more facts, so that we might nd out whether the cry of deterioration was a iere scare. He wrote a letter to *The Times* ome time ago, and that was very ably backed p by Dr. Jones, and interest had been awakened. ir John Gorst was taking a very great interest n this question, and he had put a motion down n the paper of the House of Commons, for a elect Committee to be appointed to inquire as to he best method of keeping a record of the physical ondition of children attending schools which were ided by parliamentary grants. As to the Depart- iental Committee now sitting, he thought that the entlemen composing it were too much of the nature f officials. He thought that one of the great proofs f degeneration was to be found in the reports of the Recruiting Department of the army. Year after year here was a most formidable percentage of rejections, ot only on account of specific physical ailments, but n account of lower physical vitality. This reached s culminating point in Manchester, where between o and 50 per cent. of recruits, examined by the iedical officers, were found to be unfit on account f imperfect development. Then again, Dr. Hall ad brought before the country, in a letter to *The Times*, most crucial evidence of the deterioration of chool children in Leeds under the modern system f education. There was an enormous number of chil- ren who went to school, as evidenced by Sir James Crichton Browne's inquiry, underfed, or not fed at all. t was evident that such a state of things must tend o deteriorate the physical development of the children in after life. It was a terrible reflection that possibly the commercial battles of the world in the future would have to be fought by such persons. As to juvenile smoking, a very large number of facts had been adduced to show that a tremendous de- terioration, both mental and physical, was brought about by that practice, and it had been suggested that there should be some legislation to stop the pernicious custom. There was at the present time a Bill on the subject in the House of Commons.

Dr. HALL said that for fifty years he was a general practitioner amongst women and children, and for a portion of that time he was surgeon to the Women's and Children's Hospital at Leeds. Wiih regard to physical degeneration, he thought that the want of proper food was the great cause. He could produce statistics which would show that children who were brought up in the midst of dirt, poverty, and over- crowding, could still be comparatively healthy if they were properly fed. Children needed bone- making food. The public had got on to altogether wrong lines. The organic phosphates of lime were required to make bone, and an abundance of that material was contained in the maternal milk. It might be got from other materials, but with much greater difficulty. A medical eye could detect in the streets of London, or any other large town, that a large percentage of the people had rickets. The reason of this was that they had been improperly fed before they were two years of age. In these cases the rickets cramped the vital organs, so that the children never recovered their perfect form, and led to degene- rated tissue. A rickety condition might be produced even before a child was born. Unless a good bony frame-work was produced the flesh could not hang properly on the body, and the child would be materially damaged. The degeneration associated with rickets was what was called fibrosis, and was closely allied to the degeneration caused by feeding on alcohol. [The speaker condemned the practice of feeding children by the bottle instead of with the natural milk of the mother. He exhibited a series of lantern slides show- ing the contrast between young Jewish children and young Gentile children in the same rank of life.] The Jews, he said, took a pride in providing proper nourishment for their wives and children, and this practice resulted greatly to the advantage of Jewish children, and caused them to be far superior in their general bodily condition to the children of the Gentile population. There would not be found more than 2 per cent. of the Jewish mothers who did not suckle their children; but more than 90 per cent. of English mothers declined to do so. A great deal had been said about the necessity of physical development, but every Jewish boy of seven years of age and upwards spent most of his leisure time during the day, out of school hours, at the Synagogue studying the Hebrew language and the

Talmud, and yet, notwithstanding this, the Jewish boys were superior in size and weight to the Gentile children, and had better teeth and a better bony development. Dr. Hall referred to the evils of "mouth breathing." The best advice to give to the rising generation was that they should keep their mouths shut, and become nose-breathers, instead of mouth-breathers.

Dr. HARRY CAMPBELL said that it must be remembered that the Jews for the last two thousand years had been a town-bred people, and it was not unlikely that they had become adapted to the conditions of town life, and to the conditions of diet which prevailed in towns. There must have been among the Jews during the last two thousand years an enormous elimination of children who were not able to adapt themselves to the conditions which prevailed in towns; and this might be a factor in explaining how much better Jewish children throve in towns than Gentile children. In regard to the question of diet, there was a point which, although it was not generally recognised, was of very great importance. A great defect in the diet of all classes was that it was altogether too pappy and did not call the masticatory organs sufficiently into action. He believed that the condition of mouth-breathing to which Dr. Hall had alluded was due to adenoids or the blocking up of the back of the nose and the throat, and he believed that the main cause of adenoids was that the food taken was too pappy, and that consequently the jaws were not properly exercised. He should call this age an age of pap. If the jaws were not properly exercised, there was not a proper stimulation of the circulation of the blood in the mouth. A very large quantity of starch was taken in pappy food, and this substance did not get properly digested by the saliva. If it was properly masticated in the mouth, it was converted into maltose, which was practically malt extract. But otherwise it passed into the stomach and caused trouble, and predisposed to catarrh and adenoids. Dr. Jones, among the recommendations which he had made of improving the present state of affairs, had omitted to mention the importance of impressing upon all classes that those persons who were unfit to marry, ought not to do so.

Dr. SHUTTLEWORTH said that they ought not to lose sight of the influence of heredity. Heredity and surroundings determined the condition of the individual. He wished to urge that some notion of how to avoid marriages among the unfit, should be instilled into the growing generation of young people. In the performance of his duties of examining defective children on behalf of the London School Board, one of the things that struck him most in connection with such children was the fact of their being underfed. Of those who were unable to cope with the conditions of ordinary school work, about two-thirds were simply the victims of ill-nutrition or defective feeding. Allusion had been made to the deleterious effect of tobacco smoking among young people. He should like to back up what had been said on that subject. The teachers sometimes found that the boys who came to school were in the habit of spending their halfpence, not in sweets or cakes, but in cigarettes sold at three a penny, and some of the boys had injured their physical and mental condition by smoking. There seemed to be very diverse opinions as to whether there was really any evidence or not of physical deterioration. Why should not an attempt be made in a simple manner to obtain the necessary evidence, without waiting for a report from a Royal Commission. Sir John Gorst had suggested that, in all the schools of the country, there should be a simple system of registration of the heights, weights and ages of the children. This could be carried out at a very small expense, and it would be one means of gauging the condition of the population, and in a few years we should have, at any rate, a certain number of facts to go upon. He held that it was highly desirable that all the schools in the country should be subject to a certain amount of medical supervision in order that any deviations from the normal which were going on might be ascertained. Such things were often due to ill-fitted seats and desks and various matters which could be easily remedied if they were pointed out. He thought that the teaching of hygiene and of temperance, and also of the ill results of an infraction of nature's laws should form part of the curriculum of the elementary school.

Dr. FLETCHER BEACH, referring to the subject of marriage of the unfit, said that he thought that it was very undesirable that epileptics should marry. That idea might appear to be Utopian in England, but it had been carried out in some parts of America.

The Rt. Hon. Sir HENRY KNOX, K.C.B., said that he was somewhat familiar with the practical bearing of the question of degeneration. He was inclined to agree that there was no exact proof that the race was deteriorating to the extent that some people would like them to believe, although there was no doubt that the condition of things was very bad in some places. For many years he had been in a position to watch the recruiting of the army and the rejections of the men who offered themselves, and he had found that the number of rejections made by the medical officers had been very uniform during the whole of that time. Very nearly half of the men who offered themselves had been rejected for a very long series of years, but men rejected in one locality presented themselves in another, and were rejected again, and, therefore, the statistics as to the percentage of rejections were of no value whatever. As a measure of the general physical condition of the whole populace, there was another fact with regard to recruits, which illustrated what a wonderful thing the examination of the service was. Month after month returns had come to him showing

t the doctors who had examined the recruits the army had passed youngsters of seventeen, een, fifteen, fourteen, and even thirteen years of , under the belief that they were eighteen. these cases the physique of the recruits had the doctors to pass them for the army at ages ow that at which they were legally admissible, and ir parents had obtained their discharge, and the ntry had been put to expense, which was some-es very considerable.

)r. ROBERT JONES, in reply, said that he had n quite prepared for the very optimistic opening iarks of the Chairman. He had been struck with view taken by Sir H. Knox, who was also a very n optimist. If there was no definite proof of generation, still there was no definite proof of pro-ss. He thought that Dr. Farquharson had struck nail on the head in saying that environment was great point. If we could find any practical ition of the problem of bringing the agricul-al labourer back to the land, the difficulty with ard to degeneration would to a very great extent solved. It had been asserted by Dr. Hall that d was the chief thing. No doubt food was chief contributor, but after all there were also illary matters in connection with the question, h as light, air, and healthy exercise. He was e that the little Jew boy would be very ch better if, instead of spending his leisure-e in study at the synagogue, he devoted the e to physical exercise. He (Dr. Jones) k a very strong view of the effect of en-onment, and speaking generally he thought that ironment knocked heredity into a cocked hat. thought that abstinence from marriage on the t of the unfit was a counsel of perfection on which they must not insist. Nature did always select the course which was most irable. He had been interested in Dr. Shuttle-rth's remarks as to the cases within his erience in which deterioration was due to mal-rition. Mal-nutrition was the fault of the mother, l the neglect of the mother arose from deficient ication. He felt sure that if the education of thers with regard to domestic duties, was properly en in hand, the numerous cases of the mal-nutrition children would be very much less than they were.

A vote of thanks to Dr. Jones was proposed by CHAIRMAN, and carried unanimously.

Correspondence.

THE REPRESSION OF THE BRITISH INVENTOR.

hope that Mr. Lowry's letter in the *Journal* of 19th inst. may prove the starting point for a reconsideration by the Society of Arts of the whole question of British Patent-law, with a view to urging an alteration so as to make things smoother for the inventor, who, unless a rich or influential man (which almost always he is not), has difficulties and expenses enough in all conscience to contend with in the working out and introduction of his invention in a nation whose ideas of enterprise and honour are summed up in the following couplet, which I have more than once had thrown in my teeth as a reason for not trying something new : —

> "Be not the first by whom the new is tried,
> Nor yet the last to lay the old aside!"

In other words, show no enterprise yourself, but when your neighbour has sunk money and undergone worry and anxiety in doing the pioneer work, pounce in and rob him of as much of his just reward as you can!

A question that has long puzzled me, is: Why is there such an enormous difference in the laws of patentright and copyright? Patentees and authors are both inventors, and in each case the invention may be of great, little, or no value, and be the result of much or little labour and expense. Here, however, the similarity ceases. The author can place his invention on the market at a very moderate further expense; the patentee may be impotent to proceed until he has in some way secured the application of large sums of money. There can be little doubt that on the average it costs very many times as much to put a patented article on the market as to publish a book, and takes far longer.

In view of this difference, how does the law help the patentee? It first gives him a good chance of losing protection altogether by "publication," before he files his application for a patent, and it then taxes him to the extent of £99—which in the aggregate produces, I think, over £100,000 per annum beyond the expenses of the Patent Office—in return for which it grants him a patent for the maximum term of fourteen years.

The author, on the other hand, cannot lose protection by publication—in fact he thereby obtains it—and the fee to empower him to enforce his rights is 5s. Finally, his protection lasts about three times as long as a patent. In other words, the patentee has to pay for protection 1,188 times as much per annum as the author.

Can any man say that this is just? Why should the patentee be charged so incomparably more than the author? Why should his protection be for only one-third of the copyright time? And why, in the name of all that is extraordinary, should publication in the one case prevent protection, and in the other be the means of procuring it?

W. S. BOULT,

20, Park-road,
Wandsworth, S.W.
22nd February, 1904.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock :—

MARCH 9.—"Mechanical Piano Players." By J. W. COWARD.

MARCH 16.—"Artificial and other Building Stones." By L. P. FORD. PROFESSOR J. M. THOMSON, L.L.D., F.R.S., will preside.

MARCH 23.—"The Rural Housing Question." By T. BRICE PHILLIPS.

INDIAN SECTION.

Thursday Afternoons, at 4.30 o'clock :—

MARCH 10.—"China Grass: its Past, Present, and Future." By FRANK BIRDWOOD, B.A. PROF. SIR WILLIAM RAMSAY, LL.D., F.R.S., will preside.

COLONIAL SECTION.

Tuesday afternoons, at 4.30 o'clock :—

MARCH 22.—"Cotton Growing in the British Empire." By ALFRED EMMOTT, M.P. The RIGHT HON. SIR EDWARD GREY, BART., M.P., will preside.

APPLIED ART SECTION.

Tuesdays, at 4.30 or 8 o'clock :—

MARCH 15, 4.30 p.m.—"Recent Developments in Devonshire Lace-making." By ALAN S. COLE, C.B.

CANTOR LECTURES.

Monday evenings, at 8 o'clock :—

BERTRAM BLOUNT, F.I.C., "Recent Advances in Electro-Chemistry." Three Lectures.

LECTURE I.—MARCH 7.—The present position of industrial electro-chemistry—Principal manufactures dependent on electro-chemistry—Major and minor applications—Distinction between purely electro-chemical processes and those performable chemically—Electrolytic refining and winning of metals in aqueous solution: copper, zinc, nickel, lead.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, MARCH 7...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. Bertram Blount, "Recent Advances in Electro-Chemistry." (Lecture I.)

Royal Institution, Albemarle-street, W., 5 p.m. General Monthly Meeting.

Engineers, in the Theatre of the United Service Institution, Whitehall, S.W., 7½ p.m. Mr. Frank Latham, "Some Recent Works of Water Supply at Penzance."

Chemical Industry (London Section), Burlington-house, W., 8 p.m. 1. Mr. H. de Mosenthal, "Observations on Cotton and Nitrated Cotton." 2. Messrs. W. Macnab and A. E. Leighton, "The Products, and Relative Temperature of Combustion of some Smokeless Powders."

Surveyors, 12, Great George-street, S.W., 8 Mr. Thomas Binnie, "The Land Purchases o New Naval Base at Rosyth, on the Firth of Fo

Geographical, University of London, Burling gardens, W., 8½ p.m.

Victoria Institute, 8, Adelphi-terrace, W.C., 4½ Professor Edward Hull, "Date of the Last of the Land in the British Isles."

TUESDAY, MARCH 8...United Service Institution, White S.W., 3 p.m. Mr. C. Jerram, "Short Se and the Naval Reserves."

Asiatic, 22, Albemarle-street, W., 3 p.m.

Royal Institution, Albemarle-street, W., 5 Mr. Ernest Foxwell, "Japanese Life Character." (Lecture III.)

Medical and Chirurgical, 20, Hanover-square, 8½ p.m.

Civil Engineers, 25, Great George-street, S. 8 p.m. Mr. Russell Scott Scholefield, " Erection of Iron Bridges."

Anthropological, 3, Hanover-square, W., 8½ p.m.

Colonial Institution, Whitehall-rooms, Whitel place, S.W., 4½ p.m. Mr. J. Cathcart Wa "The East Africa and Uganda Protectorates."

Pharmaceutical, 17, Bloomsbury-square, W 8 p.m.

WEDNESDAY, MARCH 9...SOCIETY OF ARTS, John-st Adelphi, W.C., 8 p.m. Mr. J. W. Coward, " chanical Piano Players."

Biblical Archæology, 37, Great Russell-str W.C., 4½ p.m.

Geological, Burlington-house, W., 8 p.m.

North-East Coast Institute of Engineers and Sl builders, Westgate-road, Newcastle-on-T 7½ p.m. 1. Discussion on Mr. B. C. Law's pa "Technical Education." 2. Mr. F. H. Alexan "Longitudinal Engine Room Bulkheads in M chant Vessels."

THURSDAY, MARCH 10...SOCIETY OF ARTS, John-str Adelphi, W.C., 4½ p.m. (Indian Section.) Frank Birdwood, "China Grass: its Past, Pres and Future."

Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

African Society, United Service Institution, Wh hall, S.W., 4½ p.m.

Royal Institution, Albemarle-street, W., 5 p Prof. H. L. Callendar, "Electrical Methods Measuring Temperature." (Lecture III.)

Camera Club, Charing-cross-road, W.C., 8½ p Mr. Alfred Hands, "Lightning, and the Scienc Protection therefrom."

Electrical Engineers, 25, Great George-street, S. 8 p.m. 1. Mr. F. F. Dennett, "The Rail Electrification Problem, and its probable Cost England and Wales." 2. Mr. H. M. Hob "The Rated Speed of Electric Motors as affect the Type to be employed."

Mathematical, 22, Albemarle-street, W., 5½ p.m.

FRIDAY, MARCH 11...Royal Institution, Albemarle-street, 9 p.m. Prof. F. T. Trouton, "The Motion Viscous Substances."

Civil Engineers, 25, Great George-street, S. 8 p.m. (Students' Meeting.) Mr. W. G. Banist "The Premium System of Payment for Labou

Astronomical, Burlington-house, W., 5 p.m.

Clinical, 20, Hanover-square, W., 8½ p.m.

Physical, Royal College of Science, South K sington, S.W., 8 p.m.

SATURDAY, MARCH 12...Botanic, Inner Circle, Regent park, N.W., 3¾ p.m.

Royal Institution, Albemarle-street, W., 3 p Lord Rayleigh, "The Life and Work of Stoke (Lecture IV.)

Journal of the Society of Arts.

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FRIDAY, MARCH 11, 1904.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

NEXT WEEK.

Monday, March 14, 8 p.m. (Cantor Lecture.) Bertram Blount, F.I.C., "Recent Advances in Electro-Chemistry." (Lecture II.)

Tuesday, March 15, 4.30 p.m. (Applied Art Section.) Alan S. Cole, "Recent Developments in Devonshire Lace-making."

Wednesday, March 16, 8 p.m. (Ordinary Meeting) L. P. Ford, "Artificial and other Building Stones."

Further details of the Society's meetings will be found at the end of this number.

CANTOR LECTURES.

On Monday evening, 7th inst., Mr. Bertram Blount, F.I.C., delivered the first lecture of his course on "Recent Advances in Electro-Chemistry."

The lectures will be published in the *Journal* during the summer recess.

INDIAN SECTION.

Thursday afternoon, March 10, 1904; Professor Sir William Ramsay, K.C.B., LL.D., F.R.S., in the chair.

The paper read was on "China Grass: its Past, Present, and Future," by Frank Birdwood, B.A.

The paper and report of the discussion will be published in a future number of the *Journal.*

THE ALBERT MEDAL.

The Council will proceed to consider the award of the Albert Medal for 1904 early in May next, and they, therefore, invite members of the Society to forward to the Secretary, on or before the 2nd April, the names of such men of high distinction as they may think worthy of this honour. The medal was struck to reward "distinguished merit in promoting Arts, Manufactures, and Commerce," and has been awarded as follows in previous years :—

In 1864, to Sir Rowland Hill, K.C.B., F.R.S., "for his great services to Arts, Manufactures, and Commerce, in the creation of the penny postage, and for his other reforms in the postal system of this country, the benefits of which have, however, not been confined to this country, but have extended over the civilised world."

In 1865, to his Imperial Majesty, Napoleon III., "for distinguished merit in promoting, in many ways, by his personal exertions, the international progress of Arts, Manufactures, and Commerce, the proofs of which are afforded by his judicious patronage of Art, his enlightened commercial policy, and especially by the abolition of passports in favour of British subjects."

In 1866, to Michael Faraday, D.C.L., F.R.S., "for discoveries in electricity, magnetism, and chemistry, which, in their relation to the industries of the world, have so largely promoted Arts, Manufactures, and Commerce."

In 1867, to Mr. (afterwards Sir) W. Fotherg Cooke and Professor (afterwards Sir) Charles Wheatstone, F.R.S., "in recognition of their joint labours in establishing the first electric telegraph."

In 1868, to Mr. (afterwards Sir) Joseph Whitworth, LL.D., F.R.S., "for the invention and manufacture of instruments of measurement and uniform standards by which the production of machinery has been brought to a state of perfection hitherto unapproached, to the great advancement of Arts, Manufactures, and Commerce."

In 1869, to Baron Justus von Liebig, Associate of the Institute of France, For. Memb. R.S., Chevalier of the Legion of Honour, &c., "for his numerous valuable researches and writings, which have contributed most importantly to the development of food economy and agriculture, to the advancement of chemical science, and to the benefits derived from that science by Arts, Manufactures, and Commerce."

In 1870, to Vicomte Ferdinand de Lesseps, Member of the Institute of France, Hon. G.C.S.I., "for services rendered to Arts, Manufactures, and Commerce, by the realisation of the Suez Canal."

In 1871, to Mr. (afterwards Sir) Henry Cole, K.C.B., "for his important services in promoting Arts, Manufactures, and Commerce, especially in

aiding the establishment and development of International Exhibitions, the Department of Science and Art, and the South Kensington Museum."

In 1872, to Mr. (afterwards Sir) Henry Bessemer, F.R.S., "for the eminent services rendered by him to Arts, Manufactures, and Commerce, in developing the manufacture of steel."

In 1873, to Michel Eugène Chevreul, For. Memb. R.S., Member of the Institute of France, "for his chemical researches, especially in reference to saponification, dyeing, agriculture, and natural history, which for more than half a century have exercised a wide influence on the industrial arts of the world."

In 1874, to Mr. (afterwards Sir) C. W. Siemens, D.C.L., F.R.S., "for his researches in connection with the laws of heat, and the practical applications of them to furnaces used in the Arts; and for his improvements in the manufacture of iron; and generally for the services rendered by him in connection with economisation of fuel in its various applications to Manufactures and the Arts."

In 1875, to Michel Chevalier, "the distinguished French statesman, who, by his writings and persistent exertions, extending over many years, has rendered essential services in promoting Arts, Manufactures, and Commerce."

In 1876, to Sir George B. Airy, K.C.B., F.R.S., Astronomer Royal, "for eminent services rendered to Commerce by his researches in nautical astronomy and in magnetism, and by his improvements in the application of the mariner's compass to the navigation of iron ships."

In 1877, to Jean Baptiste Dumas, For. Memb. R.S., Member of the Institute of France, "the distinguished chemist, whose researches have exercised a very material influence on the advancement of the Industrial Arts."

In 1878, to Sir Wm. G. Armstrong (afterwards Lord Armstrong), C.B., D.C.L., F.R.S., "because of his distinction as an engineer and as a scientific man, and because by the development of the transmission of power—hydraulically—due to his constant efforts, extending over many years, the manufactures of this country have been greatly aided, and mechanical power beneficially substituted for most laborious and injurious labour."

In 1879, to Sir William Thomson (now Lord Kelvin), LL.D., D.C.L., F.R.S., "on account of the signal service rendered to Arts, Manufactures, and Commerce, by his electrical researches, especially with reference to the transmission of telegraphic messages over ocean cables."

In 1880, to James Prescott Joule, LL.D., D.C.L., F.R.S., "for having established, after most laborious research, the true relation between heat, electricity, and mechanical work, thus affording to the engineer a sure guide in the application of science to industrial pursuits."

In 1881, to August Wilhelm Hofmann, M.D., LL.D., F.R.S., Professor of Chemistry in the University of Berlin, "for eminent services rendered to the Industrial Arts by his investigations in organi chemistry, and for his successful labour in promoting the cultivation of chemical education and research i England."

In 1882, to Louis Pasteur, Member of the Institut of France, For. Memb. R.S., "for his researches i connection with fermentation, the preservation o wines, and the propagation of zymotic diseases i silkworms and domestic animals, whereby the art of wine-making, silk production, and agricultu have been greatly benefited."

In 1883, to Sir Joseph Dalton Hooker, K.C.S.I. C.B., M.D., D.C.L., LL.D., F.R.S., "for th eminent services which, as a botanist and scientifi traveller, and as Director of the National Botanica Department, he has rendered to the Arts, Manufac tures, and Commerce by promoting an accurate know ledge of the floras and economic vegetable product of our several colonies and dependencies of th Empire."

In 1884, to Captain James Buchanan Eads, "th distinguished American engineer, whose works hav been of such great service in improving the wate communications of North America, and have thereb rendered valuable aid to the commerce of the world.'

In 1885, to Mr. (afterwards Sir) Henry Doulton "in recognition of the impulse given by him to th production of artistic pottery in this country."

In 1886, to Samuel Cunliffe Lister (now Lor Masham), "for the services he has rendered to th textile industries, especially by the substitution o mechanical wool combing for hand combing, and b the introduction and development of a new industr —the utilisation of waste silk."

In 1887, to HER MAJESTY QUEEN VICTORIA, "i commemoration of the progress of Arts, Manufacture and Commerce throughout the Empire during th fifty years of her reign."

In 1888, to Professor Hermann Louis Helmholt For. Memb. R.S., "in recognition of the value o his researches in various branches of science and o their practical results upon music, painting, and th useful arts."

In 1889, to John Percy, LL.D., F.R.S., "for h achievements in promoting the Arts, Manufacture and Commerce, through the world-wide influen which his researches and writings have had upon t progress of the science and practice of metallurgy."

In 1890, to William Henry Perkin, F.R.S., "f his discovery of the method of obtaining colourir matter from coal tar, a discovery which led to t establishment of a new and important industry, a to the utilisation of large quantities of a previous worthless material."

In 1891, to Sir Frederick Abel, Bart., G.C.V.C K.C.B., D.C.L., D.Sc., F.R.S., "in recognition of t manner in which he has promoted several importa classes of the Arts and Manufactures, by the applicati of Chemical Science, and especially by his research in the manufacture of iron and of steel; and also acknowledgment of the great services he has render

the State in the provision of improved war material, d as Chemist to the War Department."

In 1892, to Thomas Alva Edison, "in recognition the merits of his numerous and valuable inventions, pecially his improvements in telegraphy, in teleony, and in electric lighting, and for his discovery a means of reproducing vocal sounds by the phonoaph."

In 1893, to Sir John Bennet Lawes, Bart., F.R.S., d Sir Henry Gilbert, Ph.D., F.R.S., "for their int services to scientific agriculture, and notably for e researches which, throughout a period of fifty ars, have been carried on by them at the Experiental Farm, Rothamsted."

In 1894, to Sir Joseph (now Lord) Lister, F.R.S., for the discovery and establishment of the antiseptic ethod of treating wounds and injuries by which not ly has the art of surgery being generally promoted, d human life saved in all parts of the world, but tensive industries have been created for the supply materials required for carrying the treatment into ect."

In 1895, to Sir Isaac Lowthian Bell, Bart., F.R.S., in recognition of the services he has rendered to ts, Manufactures, and Commerce by his metalgical researches and the resulting development of e iron and steel industries."

In 1896, to Prof. David Edward Hughes, F.R.S., n recognition of the services he has rendered to ts, Manufactures, and Commerce, by his numerous entions in electricity and magnetism, especially e printing telegraph and the microphone."

In 1897, to George James Symons, F.R.S., "for e services he has rendered to the United Kingdom affording to engineers engaged in the water pply and the sewage of towns a trustworthy basis their work, by establishing and carrying on ring nearly forty years systematic observations w at over 3,000 stations) of the rainfall of the itish Isles, and by recording, tabulating, and phically indicating the results of these observans in the annual volumes published by himself."

In 1898, to Professor Robert Wilhelm Bunsen, D., For. Memb. R.S., "in recognition of his merous and most valuable applications of Chemistry l Physics to the Arts and to Manufactures."

In 1899, to Sir William Crookes, F.R.S., "for extensive and laborious researches in chemistry l in physics; researches which have, in many innces, developed into useful practical applications in Arts and Manufactures."

n 1900, to Henry Wilde, F.R.S., "for the disery and practical demonstration of the indefinite rease of the magnetic and electric forces from ntities indefinitely small, a discovery now used in dynamo machines; and for its application to the duction of the electric search-light, and to the ctro-deposition of metals from their solutions."

n 1901, to His Majesty the King, "in ognition of the aid rendered by His Majesty to ts, Manufactures, and Commerce during thirty-eight years' Presidency of the Society of Arts, by undertaking the direction of important exhibitions in this country and the executive control of British representation at International Exhibitions abroad and also by many other services to the cause of British Industry."

In 1902, to Professor Alexander Graham Bell, "for his invention of the Telephone."

In 1903, to Sir Charles Augustus Hartley, K.C.M.G., "in recognition of his services, extending over 44 years, as Engineer to the International Commission of the Danube, which have resulted in the opening up of the navigation of that river to ships of all nations, and of his similar services, extending over 20 years, as British Commissioner on the International Technical Commission of the Suez Canal."

Proceedings of the Society.

INDIAN SECTION.

Thursday afternoon, February 11, 1904; The Rt. Hon. Sir J. West Ridgeway, G.C.M.G., K.C.B., K.C.I.E., in the chair.

The paper read was—

OUR COMMERCIAL RELATIONS WITH AFGHANISTAN.

By Colonel Sir Thomas Hungerford Holdich, R.E., K.C.M.G., K.C.I.E., C.B.

The present time, when our relations both political and commercial with countries which lie beyond the border land of India are more or less under public discussion, is not an inapt opportunity for passing in review the conditions which govern our commercial relations with at least one of them, and that one the nearest, and, in some respects, the most important. Persia, Afghanistan, Tibet, and China flank each other in line from West to East beyond our Indian frontier; and behind them all lies Russia; and somehow or other whenever men commence to discuss what might or might not be done to facilitate our commercial relations with any one of those countries by improving our communications or adjusting our boundaries, Russia invariably finds a place in the discussion. And with very good reason. For were it not for Russian activity in the same commercial fields we might be content to let matters drift, satisfied that we have rounded off the corners of the British Empire with quite sufficient precision; that we have gone quite far enough, and that

we are now concerned above all things in avoiding further expansion which may lead to further political complication. This is only the natural result of the processes by which the Empire has been built up, processes of trade expansion unassisted for the most part by conquest; processes which, in their uneventful issues, have not appealed to the imagination or the sympathies of a great body of Englishmen, and which have left the nation divided in opinion as to whether it is a good thing or a bad thing that we should have expanded into Empire at all. But we cannot tell what the alternative might have been. All we see is that we have suffered from that sincerest form of flattery which takes the form of imitation. We are no longer alone in the adoption of commercial methods of expansion. We have powerful rivals in the field; and for most, if not quite all that affects the Asiatic field, that rival is Russia. Russian commercial policy has always appeared to me to run consistently on the same lines. First establish communications; spread out railways into untraversed spaces; capture such trade as there may be to capture, and then, if necessary, support the commercial interests thus created by force of arms; combine the military with the commercial policy, and so expand the Russian borders and increase Russian wealth. It is not a case of trade following the flag with Russia, nor has it been altogether so with us. Far more frequently trade has preceded the flag, which, however, is never slow to follow in the tracks of trade.

These things being so, I need not apologise for introducing the subject of Afghanistan. Our relations with that country now are not entirely satisfactory, although it is said to be quite beyond the pale of practical politics at present to alter them. We have made Afghanistan what it is—a very solid buffer between ourselves and our northern neighbour, and it is in every way desirable that it should remain so. Nevertheless I think that a candid and plain statement of our determination eventually to extend and improve our own commercial relations would tend to strengthen our political relations even with Afghanistan, whose rulers for a long time have been watching the rapid progress of advancing railways and expanding commerce on one side their border from Persia to China, wondering after their manner, what fashion of commercial repartee was to be made on the other. I have had the luck (good or bad) to spend some years of my life in Afghanistan, and to have been in every province of it, an in direct communication with one or two of it leading men. I know a little (not much pe haps, but rather more than most Englishmen of the temper of the Afghan people, and I d not think that it is impossible to effect th improvement we desire. Can we in any wa teach the new Afghan generation respect f our position without risking the peace of th border? If it is to be done at all it is only b convincing the Afghan son of Israel (who not always either intolerant or thick-heade that it is to his advantage as much as ou that his trade and communications should b improved, but that under any circumstanc we know our own mind on the subject, an possess a policy as definite as that of Russi Remember that whoever first threatens th integrity of Afghanistan as she is to-day, w stir up a veritable wasps' nest. Twenty-fi years have consolidated the Afghan army armed her troops with modern weapons; give her an abundant artillery; wiped out th wretched old traditions of buying up th enemy in the field, and have introduced som thing akin to patriotism in the ranks. short, that quarter of a century has done ever thing except find leaders for a campaign, an perhaps we are not quite sure even of th defect. We do not want another Afghan w on our hands. Equally certainly may we ta it that Russia does not; but it does not appe to me that there is in this fact any reason f allowing a nation which should be entirely at o with our interests, to block the way successfu and for ever to any scheme of civilised progre such as should improve our eastern tra and bring ourselves and Russia into bet accord.

At any rate, the subject opens up ma matters of interest with which I propose deal shortly (and I fear but sketchily) to-day

In the first place, in reviewing commerc relations with Afghanistan, we may enqui What is there in the country which we can out of it, and what is there not which mig be added to her present development?

Trade with Afghanistan is represented very poor figures if we are to trust Ind statistics. There are but three avenues trade with Afghanistan across the Ind frontier, and about one of them we have ve little information. Indeed, there is no syst of registration of exports and imports wh can be considered sufficiently accurate to g positive results on any of them. It is possi however, to make a general estimate wh

will indicate the progress of trade for better or worse.

The three chief trade routes connecting India with Afghanistan across the frontier, are—

(1) The northern route, by the Khaibar Pass to Kabul, from Peshawar.

(2) The southern route, by the Bolan, or Sind-Pishin Railway, to Quetta and Kandahar.

(3) The central route, by the Gomul Pass to Ghazni and Central Afghanistan.

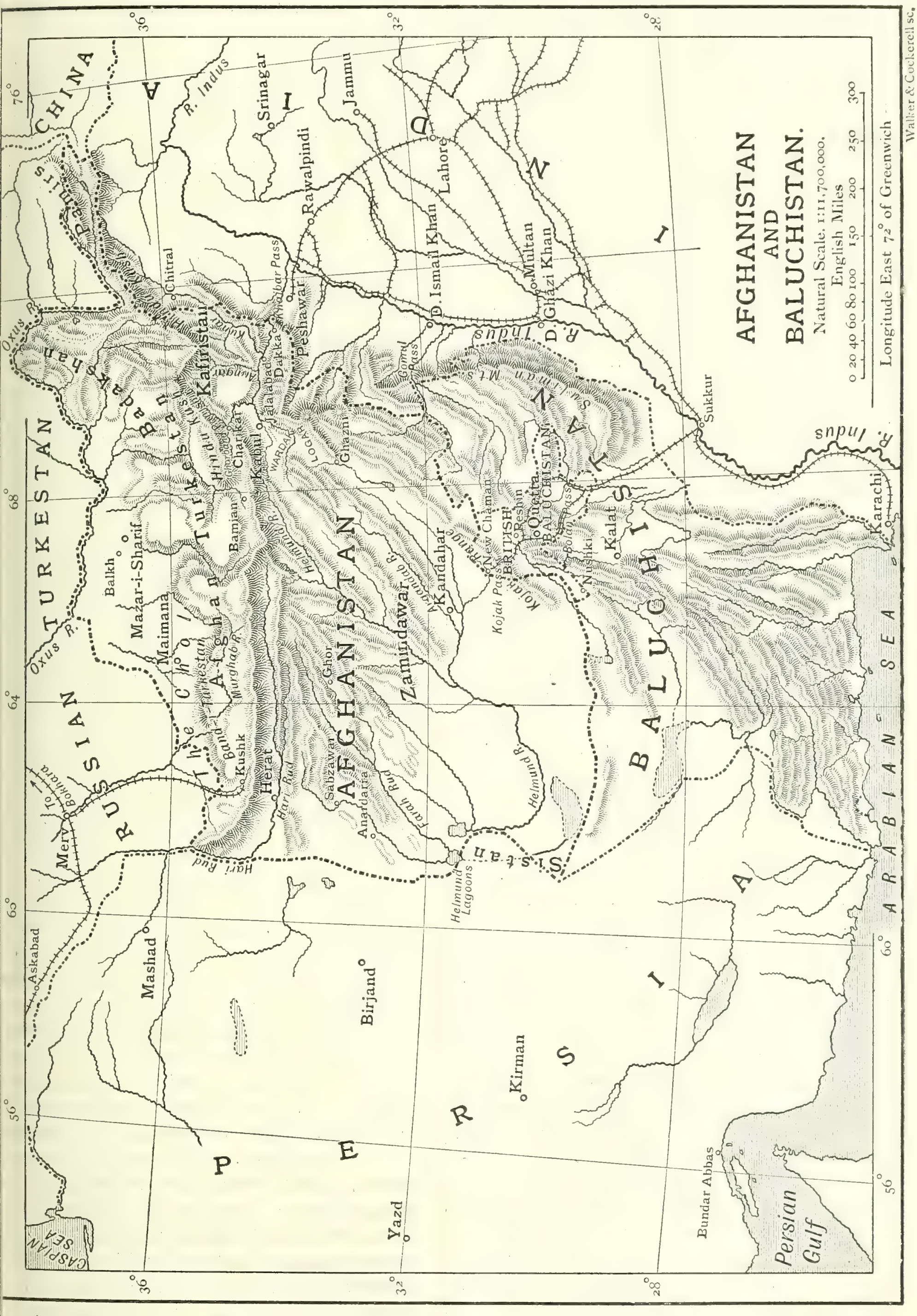
From Kabul we receive a considerable amount of fruit and vegetables (together forming the largest item in the Indian import list), grain and pulse, ghi and other provisions, asafœtida and other drugs; wool, spices, silk, and tobacco, as well as horses and cattle. The above appear to be recognised items in the import list; but besides the above, there are to be found in the bazaar at Peshawar, carpets and postins (the latter consisting of prepared sheepskins made into coats, and often highly ornamented with silk) which are very much in demand on the frontier in winter. Silks and embroideries from Bokhara are also obtainable at Peshawar in small quantities; but the heavy transit duties charged by the Amir almost annihilate trade between India and countries north of the Oxus; Bokhara trade now finds its way chiefly to Russian markets. We send to Kabul, in return, cotton goods (chiefly) with indigo, sugar, and tea (the latter mostly China leaf); and we could, no doubt, largely increase the tea trade passing through Kabul to Central Africa but for the transit duties, which are said to amount to 106 rupees per camel load of tea—say 4d. per pound. To Kandahar we send cotton-piece goods—European and Indian—which constitute three-fourths of the whole list of exports along the southern trade route between Quetta and Kandahar; and we receive fruit and raw wool in about equal quantities together with a few carpets and rugs. The Sind-Pishin Railway beyond Quetta terminates at New Chaman, which is a flourishing little frontier town beyond the Kojak range and about 70 miles from Kandahar. This would, under the ordinary circumstances, be the natural trade depôt where the khafila traffic from Afghanistan should be shifted to the railway. But the late Amir never recovered from his annoyance at the completion of the Kojak tunnel, and the construction of the railway for some seven miles beyond it down the farther slopes of the mountains. He regarded it as a violation of the Treaty of Gandamak, which fixed the frontier boundary at the northern foot of the range, and as a direct menace to Kandahar. He consequently maintained an attitude of hostility to the line itself, ignoring its existence beyond that point where it touches the southern slopes of the range at Kila Abdulla; and to this day I believe that long strings of Afghan camels are to be seen patiently toiling with their burden of wool, hides, and fruit over the Kojak Pass, moving slowly and majestically alongside the railway line, which should relieve them from the trouble of negotiating the only really difficult pass between Kandahar and Quetta. The estimated value of the trade thus maintained is about £200,000 exports to Kabul, and £170,000 imports. With Kandahar it may be rather greater; but if we make the totals £500,000 in value of exports to Afghanistan and £400,000 imports to India, we shall I think have a fair estimate of the value of trade in 1900, so far as it can be ascertained from authentic sources as maintained along the two principal trade routes.

In 1891-92 these totals were considerably larger, nearly £900,000 exports and £546,000 imports. But there was a great falling off between 1891-92 and 1897-98. In the latter year the exports were reduced to £355,000 in value, and the imports to £362,000. To what circumstances we should attribute this remarkable depression in the export figures I cannot say. It could not have been due to any increase of import duties, or to slackness of demand in Afghanistan, which was then at peace, and under a firm and secure system of administration. More probably it was due to competition from the north, and the increase of Russian goods in the markets of the country which followed the completion of the railway to Kushk. It is, at any rate, satisfactory to observe a certain tendency to recovery in the statistics for 1900, although they are very far from being altogether satisfactory, and do not compare well with the figures of ten years ago.

It will be observed that we are only dealing with the trade passing through two avenues of approach to the principal markets of Afghanistan, and that there are others intermediate which may add to the account. But the only intermediate trade route between India and Central Afghanistan of any consequence besides that of the Khaibar and the Sind-Pishin Railway, is that of the Gomul river connecting Ghazni with the frontier town of Dera Ismail Khan. Down this route every

year, there swarm a multitude of Ghilzai povindahs (or so-called merchants) bringing their wives and families with them, to spend the winter months in a congenial lowland climate, whilst they lead their strings of camels afar through the plains of India, bent on a nomadic form of traffic with the country, which takes little reckoning of central marts or mercantile depôts. Fruit is the chief article of trade; but they bring lungis—woven and embroidered in Afghanistan—with the camel's hair material known as *karak* or *barak*, and occasionally they have something to show of the products of Bokhara in their bales; but it is very little now of the silks and embroideries of Bokhara that finds its way across the Oxus or over the northern hills which separate the plans of Afghan-Turkestan from those of Ghazni. I can find no statistics of this povindah trade, but it is probably inconsiderable and not to be compared with that of the routes already mentioned. It may, perhaps, raise the value of Afghan trade to a total half a million each way—an amount which is easy to remember, and probably not far from the truth. This is about one-sixth of the nominal value of our trade with Persia; but Persia possesses a population more than double that of Afghanistan (say nine millions to four millions), and an area which is as 628,000 to 215,000 square miles, or nearly three times as great; and Persia possesses, moreover, sources of commercial wealth in her carpet making, pearl fishing, and turquoise mining industries which Afghanistan cannot hope to rival.

I do not think that trade with Afghanistan, even were its present value to be doubled or quadrupled by the removal of the heavy imposts placed upon it by the Amir, or by the development of internal resources, could ever rise to magnificent proportions. Let us consider Afghanistan somewhat in detail, and reckon up commercial possibilities by the light of what we know of Afghan geography. Afghanistan is a long, oval-shaped country, stretching through 700 miles of length from S.W. to N.E., with a general breadth of about 350 miles, narrowing to a point on the north-east, where an arm is extended outwards to the Pamirs. Right across it, from west to east (but curving upwards to touch this extended arm at its eastern extremity) is a band of mountains which separates the basin of the Oxus on the north from that of the Indus and the Helmund on the south; but which still leaves space for a river (the Hari Rud, or River of Herat) to form a basin of its own on the north-west. This band of mountain formation is the most important physical feature in Afghanistan. On the extreme west (the frontier of Afghanistan) it allows of the passage of the Hari Rud through to the desert of Russian Turkestan. Eastward of this, the mountains are for many miles but the washed down and degraded relic of a far more imposing range which has gradually silted its muddy soil downward from the crest and spread it into broad fans at its foot, until there is little of the obstruction of rugged declivities to bar the way across them. There are glens with rounded slopes, leading upwards from the extreme west of the Herat plain, which admit of wheeled vehicles being driven to the crest; and even where, above the sources of the Murghab river, the Band-i-Turkestan rises into significance and presents the appearance of an imposing range of mountains, there are few of its spurs which will prove inaccessible to the Turkoman horsemen. To the northward this central watershed (for it represents the great orographic backbone of Asia) has been washed down into an amazing sea of round headed sand waves, stretching away towards the Oxus flats and called the Chol—a waving sea of grass and flowers in summer, a blank wild wilderness of marmot infested desert in winter. Through the loess formations of the Chol the drainage from the mountains has cut its way in deep channels to the Oxus plains, but it never reaches the Oxus river. It is absorbed in vast central depressions or swamps (the home of the pheasant and the wild boar) which are cut off from communication with the Oxus by a flexure in the level of the plain parallel with the Oxus, which appears to be in progress of formation at the present time. As, however, the central water divide, or mountain band trends eastwards, it gradually increases in altitude and in breadth, rising to the dignity of snow-capped peaks and presenting most difficult passages through gorges of stupendous depth or over snow and ice-bound passes, until it merges into the S.W. extremity of the Hindu Kush. Over the backbone of the Hindu Kush, which, after dividing Badakshan from the Kabul river basin, traverses Kaffiristan and finally becomes the northern boundary of Afghanistan to the Pamirs, are passes at intervals; but they are all formidable—all effectual barriers (in spite of the late Amir's road-making) to steady traffic between the Oxus basin and Kabul. Between the Oxus basin terminating in the Caspian, and the chief markets of Afghanistan (Kabul


AFGHANISTAN
AND
BALUCHISTAN.
Natural Scale, 1:11,700,000.
English Miles
0 20 40 60 80 100 150 200 250 300
Longitude East 72° of Greenwich
Walker & Cockerell sc.
RUSSIAN TURKESTAN
CHINA
INDIA
PERSIA
AFGHANISTAN
BALUCHISTAN
BRITISH BALUCHISTAN
ARABIAN SEA
CASPIAN SEA
Persian Gulf
Kabul
Kandahar
Herat
Quetta
Peshawar
Lahore
Multan
Karachi
Sukkur
Mashad
Kirman
Yazd
Birjand
Bundar Abbas
Merv
Askabad
Balkh
Mazar-i-Sharif
Maimana
Kushk
Ghazni
Jalalabad
Chitral
Srinagar
Rawalpindi
Jammu
Kalat
Chaman
Sistan
Helmund Lagoons
Khaibar Pass
Kojak Pass
Gomal Pass
Bolan Pass
R. Indus
Oxus R.
Hari Rud
Helmund R.
Hindu Kush
Pamirs
Badakshan
Kafiristan
Sulaiman Mts
D. Ismail Khan
D. Ghazi Khan
Zamindawar
Sabzawar
Anardarra
Bamian
Charikar
Dakka

Herat, and Kandahar), there is indeed but one practicable route which might be turned into a great trade artery by means of a railway, and that is the one of which Russia possesses the northern outlet at Kushk. The central mountain band of Afghanistan could be bridged with no great difficulty between Kushk and Herat, but nowhere else that I know of between the Persian frontier and China. It follows, I think, from what I have said that whatever may be the capacity of the irrigated plains of Maimana or Balkh for increased production of cereals, or the smiling valleys of Badakshan for fruit-growing and silk-cultivation (and I believe in Badakshan as a province of exceptional possibilities, both for mineral and agricultural industries) the promise of it is not for India. No longer do the picturesque horse-drawn ferry-boats which ply between Kilif and the Afghan shore of the Oxus bring over their heavy consignments of silks and carpets, rugs, and embroidered goods, for the benefit of a country which is shut off from them by such a barrier as the central mountain ranges, through which and over which (were it not for the tea trade) hardly any trade would now pass at all. They have their railway within easy reach, and the products of the once wealthy Balkh plain and of the sweet valleys of Badakshan goes, equally with the trade of Bokhara, to the nearest railway, and will continue to do so. If we are to think of improved commercial relations with Afghanistan, we must think of that part of Afghanistan which lies nearest to us on our own side of the central barrier, where trade would naturally drift to such railway opportunities as we may give them on our border. It is of no use to think of Afghan Turkestan any longer.

There are two points of view from which we may regard such commercial relations. Firstly, there is the consideration of the economic development of Afghanistan for the good of Afghanistan itself; and, secondly, there is the prospect of improving our own position in India, not merely in relation to Afghanistan, but in relation to the British Empire. Both are largely questions of communication, and it will be found, I think, that they may be co-ordinated under two very simple heads, *i.e.*, local traffic, and "through" traffic. Let us take Afghanistan for the Afghans first, and see what there is in the country which, under a Government with a more enlightened commercial policy, might be turned to useful account. By cutting off Afghan Turkestan and Badakshan as beyond our sphere of trade influence, we limit ourselves to three great river basins, *i.e.*, that of the Kabul, the Helmund, and the Hari Rud (or Herat) river.

The Kabul river basin includes the most beautiful if not the most fertile of the romantic valleys of Afghanistan. The great affluents from the north which find their way from the springs and glens of the Hindu Kush are as full of the interest of history as they are of the charm which ever surrounds mountain bred streams giving life to the homes of a wild and untamed people. The valleys of the Ghorband and of the Panjshir are valleys of the Hindu Kush, scooped out between the long parallel flexures which are the structural basis of the system. With Kohistani villages below and battlemented strongholds above, breaking here and there into widened spaces where the ancient terraces of a former river bed are streaked and lined with the artificial terraces of modern cultivation; and the thick groves of apricot and walnut trees are grouped round the base of the foothills and the walls of the scattered villages, there is no more enchanting scenery to be found in the Alps than in these vales. To the agricultural products of the valleys is to be added a certain (or uncertain) amount of mineral wealth derived from lead and copper mines; but when all is said actual measurements show that the valleys are narrow, the acreage exceedingly small, and the possibilities of further development but scanty. Remember that the peoples of ancient Khorasan (of Persia, that is to say) and of Afghanistan, rival the yet more ancient Chinese in their capacity for developing irrigation and making two blades of grass to grow where one has been before. Whether by a system of open channels drawn from a head of blocked up mountain stream, or by the more artful and complicated system of underground tunnel (called *karez*) which will bring subterraneous water from the superficially dry bed of a mountain nullah to irrigate flats miles away from the hills, the Afghan is only equalled by the Persian in his capacity as a practical irrigation engineer. We can teach them nothing, whilst there are many parts of the British Empire (notably in South Africa) where they could teach us a good deal. But all their ingenuity and all their labour will not largely increase the irrigable area of crop producing land, and, in my opinion, the narrow limits of cultivation in these northern valleys can never be much increased, and wil

never be greater than is requisite for the purposes of local supply. The same may be said of the valley of the Kunar (the river that passes Chitral), which receives considerable affluents from Kaffiristan. I was the guest of the late Amir's Commander-in-Chief (Ghulam Haidar) in that valley about 10 years ago, and was struck with the ingenuity and thoroughness of a project for irrigation which he was carrying out by the aid of his Hazara Sappers for the improvement of a few square acres of terrace land adjoining the river, which had only been recently occupied by the Afghan force then concentrated on the borders of Kaffiristan. Every yard of it was wanted to support existing needs. The lower reaches of the Kunar above Jalalabad present the appearance of a widish plain full to the edge with cultivated fields. But you have only to look at the map to see how narrow the real space is in comparison to the great unproductive mountain masses which flank it. But where these rivers leave the mountains and unite (as the Ghorband and Panjshir unite at Charikar, or the Alingar and the Kabul river unite in the Lughman valley) to flow through an open wide area of plain of which the drainage is blocked by a narrow exit such as exists at the base of the Kabul and Laghman plains; and where the accumulated detritus of the ages (ages which are, however, geologically very recent) has silted up to an imposing expanse, there indeed is a wider prospect for agricultural development. Afghanistan is full of such plains. The plain of Kabul between the city and Charikar, and the plain of Lughman, are only two amongst innumerable instances. Chardeh and Maidan stretching beyond Kabul to the Hindu Kush westward, Logar and Wardak to the south of Maidan, and the wider spaces which flank the river Kabul above Dakka, are all instances of such formation, and all offer great opportunities for local agriculture. And these opportunities are most fully appreciated. Let us estimate the Afghan at his proper value. The great mass of the Afghan people are cultivators; patient, industrious, successful tillers of the soil. There are the proprietors who cultivate their own soil; tenants who take it on some system of rent; hired labourers; and, finally, slaves who cultivate for no wages at all. We must also include the professional water finders and *karez* makers who are usually Ghilzai of a special clan. Such a people are not likely to miss their opportunities, and, combined with their instinct for land development, they have a faculty for trading which amply supports the claim to an Israelitish origin which the true Afghan maintains. There are two harvests in the year; the harvest of summer reaping includes wheat, barley, peas, beans, and lucerne. The autumn reaping includes rice, millet, and Indian corn. It is only in the winter that the villager puts away his spade, unslings his jezail (probably he has a good breechloader now) from the nail on the wall, and is ready for that mischief which is his recreation and delight. Besides the cereal crops, the castor oil plant, madder and asafœtida abound in some localities. As for fruit it grows in such profuse abundance that it not only forms the principal food of a large class of people throughout the year, but it forms the principal export trade besides. Nor is it to be classed as wild fruit. I have eaten apples in an orchard of a village under the shadow of the Hindu Kush; melons on the glacis of the Herat fortress; peaches in the Ghorband valley; mulberries in the orchards of the Kabul suburbs, and grapes everywhere, which are not to be matched by any European production. It is a great sight to see the fruit-laden donkeys coming in from the Kabul plain to the city, plodding their way through the green fields in summer (which turn to such inconceivable dust in winter) or picking their steps down the precipitous paths which lead up the mountain steps of towns clinging to the hill sides. There is no lovelier mountain-built town in Italy than Istalif amongst the Hindu Kush foot hills a day's march north of Kabul; there can be no softer, peacefuller, sweeter view anywhere than that across the waving, shimmering fields of wheat in early summer, when the Valley of Logar is full of the aroma of the scented willow, and the little flower-bordered rivulets and canals wander through a tangle of roses, carrying thousands of pink and white petals from the overshadowing fruit trees, wandering through the soft blue haze to the distant river, or finding a rest in the open fields; when the mountains are turned to tender shades of green and grey, and the distant villages clinging to them look faint with the coming heat of mid-day. Afghanistan then indeed looks like a veritable land of promise. But is it a promise of commercial wealth? To a certain extent, yes—but that extent has definite limitations.

Let us turn to Central and Southern Afghanistan. A very large space of the Central Afghanistan which we are con-

sidering (which you will remember has nothing to do with Afghan Turkestan) is occupied by the long spurs of the great mountain mass beyond Kabul, over which runs the high road to Bamian and the Oxus. There are other high roads, specially developed for trade purposes, to the north of Kabul, but we have no time to speak of them. They lead northward. These long spurs extend southwestwards till they reach Kandahar, and they enclose the valley of the Helmund, the Argundab, the Farah, and other rivers—all of which drain to the Helmund lagoons. All the northern parts of them, about the highly-elevated base from which they spring, possess a well-merited reputation for bleak, inhospitable, unproductive savagery. There is no more unpromising land in Asia than the wind-swept home of the Hazara tribes, over a great space of its northern surface. South of the finger-ends of these radiating spurs, is the Helmund desert stretching to the Baluch frontier. There is nothing to be made out of this part of Afghanistan. East of the Hazara mountain system is the comparatively narrow plain between Ghazni and the frontier tribes which admits of intermittent cultivation, but is still very rough and very much broken by stone-covered ridges; and west of it is Sistán and the Persian frontier. All the agricultural wealth of Central and Southern Afghanistan is concentrated in the comparatively narrow valleys which, with a south-westerly trend towards the Helmund lagoons, intersect the mountains. Beyond these is the exceedingly narrow valley of the Helmund itself, traversing the desert to its end in the lagoons—and there is nothing else, to the southward. This does not seem a promising field for development. So far as mineral wealth in these geologically recent and tertiary fields is concerned I believe there is nothing important, if we except the marble quarries of the Helmund desert. But this part of Afghanistan is by no means so profitless as it appears at first sight. We must remember that it was within the embrace of these hills that the ancient capital of the kingdom, Ghor, once stood, and the ancient trees and extent of walled ruins still existing about Taiwara certify to its importance in days gone by. There is little but ruins now about the site of Ghor; but it does appear as if for once the Afghan had neglected his opportunities for re-development. South of Ghor, about the southern ends of the long spurs, there is beyond doubt some of the richest land in Afghanistan. Indeed it may be doubted whether the agricultural wealth of the lower Argandab (which makes Kandahar), of Zamindawar, of Farah, of Sabzawar, and of the narrow Helmund valley, when added to the carpet-making industries of Anardarra, do not equal those of the Kabul valley and Logar and Wardak. To put it shortly, the agricultural and commercial wealth of Southern Afghanistan is considerable, and it is concentrated on the road connecting Herat with Kandahar.

Finally, we have to consider the valley of Herat a valley which is full of flourishing villages and of well-developed cultivation throughout that part of it which can be made subject to irrigation. But that part has very definite limits; and I think that the impression made by the magnificent vista of green cultivation and extensive orchards which may be obtained from the walls of the town, contrasted with the comparative sterility of its surroundings, has led to an exaggerated idea of its wealth. At least, the conclusion which we arrived at after collecting such information as was available on the spot in 1886 placed very definite limits indeed to its powers of supply in case of military need.

Such, then, in very wide and general terms are the agricultural conditions of Afghanistan and of them, it may be said, referring to the whole country, that its productiveness in agriculture is not much in excess of its local needs. The requirements of its own population absorb nearly all its produce and leave little but fruit to be made available for the benefit of the outside world. Nor is there in the opinion of expert geologists much to be hoped for in mining developments. But if we turn from agriculture and minerals to manufactures, we find them important, and to these might be added a trade in horses which could be very largely developed much to the benefit of India if the Amir's restrictions permitted it. The largest opportunities for improvement appear to be in wool production. I have already explained that the possibilities of agriculture are restricted to the valleys, but beyond the valley is the mountain area covering three-fourths of the country, some of which, at least, is specially favourable for sheep pasturage. This is notoriously the case in the south, where the sheep of Baluchistan have been famous in history for their wool. Until the boundaries between Persia and Afghanistan were freed from the effects of periodic raids and the perpetual lifting of flocks and herds, it was impossible to expect pastoral developments along that frontier. But it is

precisely that frontier, with its intermittent expanses of open dasht (or talus) rising to the ridges of a disintegrating mountain system, which is most favourable to sheep farming; and it can hardly be doubted that it has largely developed during the last ten years of peaceful occupation, although even now the boundary is not recognised as undisputed. Throughout the whole length and breadth of Afghanistan I have seen no part of it which I consider so open to general improvement in the direction of either pasture or agriculture as these hills and plains of the Persian frontier.

Nevertheless, when all is said it must, I think, be admitted that regarding the commercial question from the local point of view alone, there is not enough to justify any large outlay in the improvement of communications by railway construction for the benefit of Afghan trade. We should not carry a railway through the difficult defiles of the Mohmand country to Kabul merely to bring down fruit to Peshawar. Nor should we advocate a southern extension of the Sind-Pishin line (although it would carry more promise with it) simply for the benefit of the Achakzai shepherds of Zamindawar, or the Tajik agriculturists of Herat. We might be reminded that commercial relations with Sistan have not proved a success; but that is not really a case in point; for Sistan is small and insignificant compared to Southern Afghanistan, and the desert journey between Sistan and Nushki is long, and there is but a poor market at Quetta, when it is finally reached. Let us now turn briefly to the other view of our commercial relations with Afghanistan—the Imperial view, and the possibilities of advantage to the British Empire.

Into the strategical question we have not time (even if this were the place) to enter. Briefly, it may be summed up in this, that we may be compelled one day to hold Jalalabad on the north, and Kandahar on the south, and that a railway to either place would become a strategical necessity. But I look on this strategic necessity as a long way off at present, and am not in the least prepared to advocate railways on such principles. But I am an advocate for a comparatively short and easy connection between the Russian and Indian railway systems, which, passing through that part of Afghanistan which holds out the best hope of local commercial development, would unite civilised East and West by the first great iron link that the world has ever seen. I do not suppose that there is anyone here who would not be an advocate for a policy of good understanding with all our European neighbours. We do not want to be in a perpetual condition of simmering agitation about the expansion of Russia, which will certainly continue to expand, impelled by a principle of national development which is common to all nations of the world, until it reaches its natural and inevitable limit. Nor do I think we need be nervous about where and when that limit will be found. Year by year we are ourselves approaching our own limits, just as Russia is approaching hers. Year by year, too, is the principle that it concerns all nations to maintain the balance of power evenly by means of peaceful negotiation rather than by force of arms becoming more and more the business principle of the world's diplomacy. It is, to my humble thinking, but a natural phase of human evolution which will certainly prevail in the end—an end which seems as if it were almost within measurable distance already. When two great rival republics in South America, armed to the teeth for a final struggle for supremacy, are content at the last moment to appeal to a business arbitration and abandon their own hereditary instincts for a free fight in favour of free intercommunication and a better knowledge of each other in the peaceful walks of life, I regard it as a notable sign of the times. I certainly regard facilities for intercommunication, and the better and wider international understanding which inevitably follows it, as one of the great peace agencies of the world, and I cannot understand those who think that because the way is open and plain between your neighbour's home and your own, and you have come to know him and he, you, that it must eventually lead to burglary on the one side or the other. I know that some of our best and cleverest authorities on Afghan politics look on railway connection as offering a fatal opportunity to Russia to invade India. But this is a military question; and I deny that any single line of railway can be made an efficient instrument for defence on one side without it being equally efficient for defence on the other; and I also think that in our ignorance of Russian frontier politics we are crediting her with a little too much foolishness when we assume that she is prepared in these latter days for such a terribly hazardous venture as a movement on India. She knows our strength better perhaps than we do ourselves. However, setting aside these political and military considerations, and setting aside local Afghan interests, we shall, I am sure, be all

agreed that if it could be proved that such an important link in the world's chain of railway network must lead to a strong unity of commercial interest between the two great powers of Asia, it would necessarily involve very serious consideration on both sides before such interests were thrown aside in favour of any warlike policy. I might take the influence of the Suez Canal on the world for peace as an analogous case in point, for it is to the interest of the whole civilised world that the Canal should be kept open.

The distance from London *viâ* Moscow to the Caspian, and thence by Herat to the Indian frontier, is roughly about 4,000 miles, and it represents 4,000 miles of most interesting travelling through a climate which is favourable all the year round. Say that the journey would occupy ten days from London, allowing of rests once or twice *en route*, and that it could be done under pressure in a week at an average of 25 miles per hour (even allowing for the steamer crossing of the Caspian), we have at once an interesting reduction on the 17 to 20 days' steamer time from London to Bombay. We might be justified in assuming that there would be no break on the Caspian, and that for a part of the route at least express rates of speed would be maintained. In that case the reduction in time would be even greater. Our mails would certainly arrive within a week from India. As regards expense, we are perhaps not so well justified in assuming that the general low rates maintained in Asiatic Russia would be continued for first-class passengers; but if we take them as they stand at present, the cost through Russian territory would be something under £15. We might add another £15 for the two ends of the line, and £5 or £6 more for the restaurant car, and still be about half-way to the present cost of a first-class passage by the P. and O. Company, whose rates appear to be the same now as they were 25 years ago, and who are at present able to defy competition. As for traffic returns will anyone look at the weekly lists of passengers to India by our big steamers, and compare them with the lists of 30 years ago? He will then form some conception of the enormous increase in numbers of people journeying to India from the West in the traffic season. A through railway service in half the time, at half the expense, would soon double even the present figures; in short, it is impossible to say to what these figures might not extend. There would be no slack season such as is held to justify the charges for steamer passages. It would flow, if not evenly, at leas all the year round. I will say nothing abou goods freight, for it is impossible to forecas its extent. We have only the experience of th Trans-Siberian Railway, which has had to b doubled to meet the increasing traffic ove parts of the line. Nor need I refer to the loca traffic between Herat and Kandahar, and th developments which might be expected ther So much for England. What would Russi gain? A well-informed Russian engineer tol me that from the trade point of view they woul expect to lose. We should draw off fro Central Asia much of the goods traffic that no gravitates to Russian lines, because our sea ports are so much nearer. However that migh be, the gain to Russia of a steady flow of pas senger traffic through the country would i itself be enormous. I wish I had time to ente into statistics showing the gain to any countr accruing from the money spent in it, and th goods brought into it, over a long route with continuous trans-continental flow of travellers It is through traffic which in days gone by ha enriched half the countries of Europe. Rus sians would be delighted to welcome Eng lishmen in their country. It may sound rathe paradoxical to say so, but I believe there is n country in Europe in which the educate classes are so well affected towards th English, and so ready to make friends. If yo do not believe it then ask any officer who ha been to Russia, and lived amongst Russians So far, however, the gain to Russia may strik you as problematical, but you must remembe that under any circumstances she has little o nothing to risk. The construction of the lin from Kushk to Herat would be a mere trifle and the loss of local Afghan trade would no affect her seriously. But the real, solid, gai to Russia would be the mail contracts betwee England and India, and I do not hesitate t say that for those contracts she would risk good deal. She is most anxious to get them Now, if Russia effected a solid commercial gai by this arrangement; and if we on our sid halved our expenses and our time in reachin India, would it, or would it not, be the cas that there would be sound reason for keepin the peace between us? Even as things stan I never can agree with those who preach tha India is in any great peril from Russia although at the same time I agree entirel with the useful precaution of a buffer state But I believe that with mutual commercia interests in (and very much beyond) Afghan istan such as I have outlined the chance c

ıy aggressive movement towards our borders ɔuld be shelved eternally.

You may ask "Why run the line through erat? Why not make the connection ırough Persia? There are various ways by hich this may be done." It is true that there ·e, but there is no way so short, so simple, so ısy, so effective, so inexpensive, as that by [erat. I have said something on this subject lsewhere, and I am not going to enlarge on it ow. I have spent much of my life in orga-ising and directing surveys in this part of .sia, and I can only express my opinion that ıe Herat to Kandahar route is an inevitable nk in the great chain of communication :tween East and West. There may be others ventually, but this will be the first and the est.

One last question. What prevents our ıaking the connection? The answer is very mple. The Amir prevents it. He will not ave a railway in Afghanistan at any price, nd it would probably cost a war to induce im to change his mind. Therefore, such a ne is ignored as a possibility, and is placed ı the category of things outside the pale of ractical politics. Consider the position of ıe Amir. He is the ruler of a country but alf awake to the benefits of civilisation. He as heard of Europe but never seen it. He is ıe centre of a court of sycophantic adherents ho will tell him that which he desires to now and nothing else; who persuade him ıat he is the responsible Power which is to eigh the pretensions of two great European owers in the balance and decide on their estinies. He naturally asks which is the reater Power; and the answer is Russia—for .ussia looms far more largely in the imagina-on of the Afghan than does England. It is ue that he receives a subsidy from England, ıt he is often too proud to touch it, and ;nores its existence for months, if not for ːars, in a spirit of proud and independent ɔntempt. Shut off as he is from all communi-ıtion with the world outside his own, his ːnse of his dignity and strength increases ːar by year with the increase of the homage hich he receives and the accumulation of his rces and his weapons of war. He is no fool, · he would not be where he is, but he is ;norant, and the knowledge that no English-an dare set foot in his country in itself ssures him that he is practically an independ-ıt sovereign who can dictate terms rather ıan accept them. That is to say he is ıman; for you and I would be just the same in his place. But is this right? Is this the position that a useful native ally should assume with reference to England? Is there no way short of war of teaching him that because England stays her hand from interference she is still a strong Power and a ruling power so far as Afghanistan is concerned? It seems to me that there is a way, and that way would be a direct agreement with Russia as regards this railway.

Habibulla feels himself equal to playing with either Power, but he would speedily recognise the futility of opposition to both. He might play with one against the other, but surely never play single-handed against both. This, then, seems to point to a solution of a problem in frontier politics, with which, after all, I have nothing to do, and which may possess other aspects of which I am ignorant. But under present conditions it does not appear impossible; and should it prove to be the real solution—the end of our everlasting difficulties with Afghanistan—then, indeed, we should find that our commercial relations with that country underwent a most marvellous change. I have said that only in certain directions do I consider that the country itself is capable of further development; but I do not mean to suggest that we obtain the full value of such development as already exists. Judging from the fluctuating value indicated by statistics we do not get half of it, and the difficulty in the way is the difficulty of the Amir's restrictions on imports. Only persuade him that his own interest, as well as ours, is involved in freer intercourse and more open trade relations, and even Afghanistan may become an important factor in the gradual development of our own Imperial resources.

DISCUSSION.

The CHAIRMAN said that in the paper there was little room for criticism, and a great deal of room for admiration. He thought, too, that there was very little room for difference of opinion. They were, probably, all agreed that it was most desirable to throw open Afghanistan, and, through Afghanistan, Central Asia, to trade and commerce, provided that they could do so without paying, politically or otherwise, too high a price. The proviso was an important one, for there was a political element as well as a commercial one; and who would deny that the political element dominated the situation, and that the commercial factor must take a back seat? We had deliberately and, he believed, wisely, made Afghanistan a buffer State between ourselves and

Russia; and, in order to be an effective buffer, it must be internally independent. Her ruler must be strong, and must be able to preserve order inside and upon his own frontier; and, in order to be strong, he must be respected and, indeed, feared by his subjects, and he must avoid ruffling the religious susceptibilities of the fanatics. If we obliged him to take another course we should become responsible, and we should be bound to maintain him and to interfere by force of arms in case of revolution. If such interference became necessary, annexation would follow as surely as the sun rose in the east, and then there would be an end of the buffer policy. No doubt there were some people who would favour such a result. Personally, he had always been in favour of the buffer policy, but still he recognised that it was merely a temporary and provisional policy, and that, sooner or later, the annexation of Afghanistan or a great part of it would probably be forced upon us. The policy of the buffer State depended upon the ruler of Afghanistan being strong and loyal. We should be living in a fool's paradise if we expected a succession of Habibullas. The day might come when there would be a weak and disloyal ruler, with disorder either inside the country or on its frontiers. Then we should be bound to interfere, and that annexation which we desired to postpone would follow, and our frontier would be coterminous with Russia. Then, and not till then, would be made the connection between the Indian and the Russian railways which the author of the paper wished to see; but no wise man would wish to precipitate that day by one hour. Consequently, there arose the question how far we could develop our commercial relations with Afghanistan without imperilling the policy of the buffer state. Sir Thomas had told them the Amir would not have a railway, and he had been a little hard on the Amir, and had attributed his refusal to arrogance and a desire to dictate to England. Could there not, however, be a more patriotic motive? Did anyone believe that a railway connecting India and Russia could run through Afghanistan without interference on our part with the interior administration? And could anyone believe that Europeans could be allowed to visit Afghanistan and travel through it without misunderstandings, without collisions, and without interference? Then was the Amir wrong? Was he not wise in his generation when he tried to keep up the policy of isolation. He (the Chairman) was strongly opposed to Russia being called in to help in securing railways in Afghanistan. Russia must be kept out of that country. Afghanistan was outside the sphere of influence of Russia, and to invite her to interfere either morally or physically would be to repeat the story of the introduction of the wooden horse inside the walls of Troy, "I fear the Greeks and their gifts." The whole question was how far we could develop commercial relations with Afghanistan without jeopardising our wise policy of the buffer State. Possibly the Amir might be persuaded to allow a railway to Kandahar especially under Afghan management. If he could be persua[ded] to do it by his own free will so let it be, but he ou[ght] not to be coerced. Again, something might be d[one] to remove the vexatious transit duties, even if it w[as] necessary to increase the subsidy by an equival[ent] amount. The enterprising planters of Ceylon [had] already made attempts to improve their tea trade [in] Afghanistan, and they had a paid agent there w[ho] was successfully selling their tea. It seemed that [the] only issue to be decided was how far commercial re[la]tions might be developed without endangering [the] present policy. It would not be wise to do anyth[ing] in the pursuit of commerce which would have a p[re]judicial effect on the *status quo*. The game was [not] worth the candle.

Colonel C. E. YATE, C.S.I., C.M.G., said that [he] cordially concurred with what Sir Thomas Hold[ich] had said about the friendship and hospitality sho[wn] to Englishmen in Russia. He knew of no country [in] the world in which the British officer, going as [a] traveller, was received with greater kindness a[nd] hospitality than in Russia. But, on the ot[her] hand, there was no country in the world in whi[ch] the British officer who was on duty met with great[er] opposition. He could honestly say from a convers[a]tion which he had with a high Russian official th[at] the Russians cordially wished for the railway throu[gh] Kandahar and Herat to Russia territory, as adv[o]cated by Sir Thomas Holdich. While travelli[ng] through Russia he received a message that a certa[in] General would be glad to see him. He was mo[st] kindly received by the General, who, presently beg[an] to dilate on the advantage of joining the Indian a[nd] Transcaspian Railways, if only to show to the wor[ld] the friendship that existed between the British a[nd] the Russian Governments. After a time, he (Colon[el] Yate) said, "You have put a customs cordon a[ll] along the Russian frontier, and you have put a[n] entire stop to all Indian trade. How are you going [to] make the railway pay?" The General replied, "W[e] only tax manufactured articles. We do not tax ra[w] material." He (the Colonel) then asked, "Wh[at] raw material would you take from us?" The repl[y] was, "Rice." "But surely rice mostly comes fro[m] Burma," he (the Colonel) answered, "Surely [it] would be much cheaper to send it direct by sea t[o] Odessa or Batoum, than across from Rangoon t[o] Calcutta by sea, and then all across India an[d] Afghanistan by rail." The General then suggeste[d] "Wheat." But he (the Colonel) answered, "Indi[a] is a great wheat-producing country. We do no[t] want wheat from Russia. Besides, you have no[t] enough for yourselves, in Transcaspia, as it is." A[t] last the General could suggest nothing to send bu[t] asafœtida, but to this his reply was, "One train [a] year would carry all the asafœtida that we require." At last the General said, "Such a railway is not a thing to be constructed by a company for the sake o[f] gain. It is an Imperial work to be undertaken b[y] the Governments concerned for Imperial purposes

ook at us. We are building the Merv-Kushk Railvay, and that will never pay a cent. in a century." When he (the Colonel) asked, "If the railway vas made out of friendship for England?" The General saw the joke, and said, "No, we are building it to defend our interests in China and on the Bosphorus." They parted the best of friends. Several years had elapsed. He did not think the commercial prospects of such a line were any brighter now than they were then.

Mr. J. D. REES, C.I.E., said that he wished to ask Sir Thomas Holdich a question about the tea trade. Did he mean by his statement regarding China tea hat Indian tea did not penetrate into Afghanistan? The fact was that the trade over the extension of he Quetta Railway, at any rate, to which reference had been made, was chiefly in Indian tea, until the ariff was lately raised under the Russo-Persian Convention. Was there no Indian tea going into Afghanistan proper; and did the Amir's policy in ny way impede the development of the tea trade? He used to hear a great deal in Moscow and other parts of Russia about the superior enterprise of the Ceylon ea planters, as compared with that of the Indian tea rade. If it was a fact that no Indian tea went into Afghanistan, he should be glad to be informed of it. t had been very interesting to hear Afghanistan escribed in the paper as a peaceful commercial and gricultural country. Most Englishmen who knew he country had been accustomed to look upon it, in he words of Sir Alfred Lyall, as—

> "A land which is red with the blood of kin,
> Where brothers embrace on the warfield,
> And the reddest sword must win."

The aspect which had been put before them in the aper was a very delightful one, but in the interest of ruth he was bound to say that he thoroughly disgreed with Sir Thomas Holdich and Colonel Yate in heir statement that the English officer and Englishmen generally were popular and welcome in Russia. He made that statement with regret, for he felt a ersonal liking to the Russians, and particularly to he Russian peasants, having lived among them to ualify as an interpreter; but he must say that the osition of Englishmen in Russia was very different rom that which they occupied in every other country, nd St. Petersburg was the only capital he knew of n which the English community were practically a eparate caste, and did not mix in social intercourse with their neighbours, as was common in other apitals in Europe. The feeling for a long while fter the Turkish war was strong against us. Though t this juncture he would be very unwilling to say a word unfriendly to the Russians, yet it was useless to hut our eyes to the existence of a keen and perpetual rivalry, and to a persistent endeavour to oust s from the hegemony of the East. With regard to the uestion of railways, he thoroughly agreed with the iew of Sir West Ridgeway, and he doubted whether he Amir would be altogether pleased to hear of the impending partition of his country, or to find that anybody at that meeting could contemplate an arrangement with Russia for making a railway through it. The Amir was exceedingly well posted in everything that took place in other countries, and everybody who knew the East must feel that he was truly patriotic in objecting to a railway going through his State. Even the limited independence which existed in the Native States of India disappeared in railway precincts when a railway went through the district. Every Englishman should in every way deprecate the making of a railway through Afghanistan. It was most to our interest to stick to the blue sea, and on this he hoped England would ever remain the greatest power.

The Hon. JOHN FERGUSON, C.M.G., asked whether Sir Thomas Holdich could give the meeting some idea of what would be the result of the commercial development, especially in respect of teas, supposing that the transit duties were reduced or removed. If there was a prospect of a large trade in tea, no doubt the desire to bring pressure on the Government to raise the subsidy and to remove the transit duties would be very much increased. With regard to Mr. Rees's remarks it should be known that there was no practical rivalry between the planters of Ceylon and those of India. They were all in exactly the same boat, and they were working together to increase the taste for tea throughout the world. Russian firms had opened branches to buy tea in Colombo, and had lately added branches in Calcutta. He only wished that the Mother Country could see her way to reduce the war duty on tea even to the extent of the transit duty, which was only 4d. a lb., while the Imperial duty on their staple was 6d.

Sir THOMAS HOLDICH, in reply, said that, with regard to the question about tea, he confessed that he was speaking from the statistics of some years ago. He knew nothing of what had been happening during the last few years. Three or four years ago the only tea which found its way through Afghanistan was China tea, and, while in that country, he never to his knowledge tasted any tea but that of China. If restrictions on import were removed, Afghanistan would be a splendid country for the tea trade. He could not think of a better field. Every Afghan notable of any consequence offered tea to his visitors. As to the Amir's objections to allowing a railway, it had been made pretty clear in the paper that those objections were solid ones. The object of the paper was to show that it might be possible to get the railway if England and Russia came to an understanding about it. The line would be on the extreme outside limits of the western boundary. If it was only shifted across the river it would run through Persia instead of Afghanistan. It would not be in the same category as a railway to Cabul would be. It would not be necessary to take the railway to Kandahar at all. It could go to India without that. As to the railway to

Merv, he knew that it was built for political purposes and not for commercial, but it would be equally useful for commercial purposes.

The CHAIRMAN said he thought that, when the Amir read the opinion that the annexation of his country could only take place in the event of a weak or disloyal ruler being on the throne of Afghanistan, he would be completely reassured as to the safety of his position. Sir West Ridgeway then moved a vote of thanks to Sir Thomas Holdich. The paper had been an admirable one, and contained a mass of most useful information in compendious form, concisely and precisely stated. The paper had been beautifully illustrated. The views must have brought home to the memory of some of the audience, and to the imagination of others, many charming and interesting scenes in Afghanistan.

THIRTEENTH ORDINARY MEETING.

Wednesday, March 9, 1904; SIR JOHN FREDERICK BRIDGE, M.V.O., Mus.Doc., in the chair.

The following candidates were proposed for election as members of the Society :—

Fleming, Dr. Andrew Milroy, C.M.G., Salisbury, Rhodesia, South Africa.
Harvey, Robert, M I.Mech.E., 27, Mincing-lane, E.C.
Herzl, Dr. Theodore, 29, Haizingergasse, Vienna, 18, Austria.
Keating, William, 42, Osborne-road, Stroud-green, N.
Lewis, John Thomas, Gas Works, Wellingborough.
Lort-Williams, John Rolleston, LL.B., 2, Paper-buildings, Temple, E.C.
Preston, John Roger, Yealand, Carnforth.
Tiffany, Frank, 3, Kelso-road, Leeds, Yorks.
Tipson, A. S., The Mitcham Japan and Varnish Company, Limited, 5, Bishopsgate-street Without, E.C.

The following candidates were balloted for and duly elected members of the Society :—

Armstrong, Miss C. M., 31, Hereford-square, S.W.
Bonny, Harry, Stafford-house, Church-end, Finchley.
Burbidge, Richard, 21, Hans-mansions, S.W.
Clark, Edward James, Hart Accumulator Company, Limited, Marshgate-lane, Stratford, E.
Clough, George Benson, Bracken-knoll, Oxshott, Surrey.
Darley, Cecil West, I.S.O., M.Inst.C.E., 34, Campden-hill-court, Kensington, W.
Deiró, Sebastiao Clementino, O.I.C.V.V., Vice-Consul for Brazil, 20, Quay-street, Manchester.
Keys, Robert Peake, Wharncliffe, 237, Devonshire-road, Honor Oak-park, S.E.
Sutton, Leopold Arthur, 36, Chancery-lane, W.C.

The paper read was—

MECHANICAL PIANO PLAYERS.

By J. M. COWARD.

What is a Piano-Player? How does it work? and What is required to be done to pl it?

These are queries which all, who have knowledge of pneumatic piano-player attac ments, naturally require explained; and this will endeavour to do.

The simplest form of mechanical pian player is probably the familiar instruments the streets, which hammers out well-knov airs in unvarying fortissimo while an Itali maestro laboriously turns a handle. For tho who do not wish to take any trouble whateve there are the electric pianos of Messrs. Imh and Mukle—that is to say, a lever-drive mechanism, the motive power of which is pr vided by electricity, attached to an ordina piano. The performer can start the machin lie down on the sofa, listen to the music, an watch the notes on the key-board bob up an down mysteriously, as though manipulated b a musical ghost; or, if he prefers it, he ca work the loud and soft pedals of the piano i the usual manner, and, in the latest model can exercise some control over the time.

The next type of machine is the one exempl fied by the striking mechanism being actuate by levers, and the motive power provided b the performer working a pair of pedals Various ingenious additions have been mad to recent models. By the action of a skilfull pivotted bar the treble can be damped off fror the bass and *vice-versâ*, and this without a arbitrarily abrupt break. The mechanism ca also be fixed on to any piano under the key board, and need not be removed if the instru ment is to be played on in the usual fashion The performer has control of the time, an can work the loud and soft pedals by means o hand levers. The music consists of rathe cumbrous rolls of perforated cardboard.

It is from the various types of pneumati piano-players that some of the best artisti results are obtained. There are several different makes. The main principle is alike in al of them.

In appearance they resemble a small harmonium, only instead of a key-board a row of hammer-fingers projects out at the back, over the notes of the piano. The instruments can be easily wheeled away, and do not interfere with the ordinary use of the piano. Among

he best known makers are the Pianola, the ngelus, the Chase and Baker Piano-Player, he Cecilian, the Simplex, the Apollo, and last, ut not least, the Metzler A. I. Piano-Player, nd the Metzler F 5 Piano-Player. The music or all these, consisting of perforated paper, is ractically the same, and is, in some cases, iterchangeable.

The perforated sheet, the mechanism comion to piano-playing attachments, as well as elf-playing pianos, first appeared in a French atent in 1842. The United States patent or the key-board piano-player was issued to . D. Bootman, 18th December, 1860, and the rst pneumatic piano-player was patented in rance in 1863, by M. F. Fourneux, and etween 1879 and 1902, the total of 55 patents ad been issued in the United States, the first omplete was the Angelus, 1897, the Pianola ollowed 1898, and the Apollo in 1900.

The pneumatic piano-player is the product outcome of ceaseless experiment, and over venty years' experience in the manufacture of neumatic instruments and perforated music aper of many different styles. The ideal is ery difficult of attainment, and the points hich go to make an ideal piano-player are many and various, it is not at all surprising ey have been difficult indeed to achieve.

The brains, the energy, the labour, patience nd capital, represented in a product such as e piano-player is never conceived or realised y those whose experience is confined solely to e finished instrument.

I will endeavour to explain some of the oints which appeal to the musician, and hich should influence purchasers, in the noice of a piano-player.

The essential of all music is time, and the oul of all music, expression. The chords of e most beautiful composition may become lmost as irritating as discords, if improperly xpressed, and to obtain proper expression, e first consideration is the rendering of the omposition correctly as regards time; as the eauty of even simple compositions is entirely poiled if reeled off in a mechanical, lifeless anner. Here the delicately arranged *tempo* ver gives the performer absolute control of e duration of every note. The second conderation is the striking of the keys of the iano with a force of varying intensity, repreenting as it does the technique of the usician. The third consideration is in being ble to adapt the degree of stroke to any articular note or chord instantaneously, and ithout affecting the chords immediately preceeding or following those required to be emphasised.

Now the extremely sensitive pneumatic action, combined with the accentuating lever, the pedal lever, and the markings on the music paper enables the performer, after a little practice, to obtain the most exquisite and human-like effects of expression. It should be borne in mind that there are various degrees of capacity of expression in the different styles of piano-players now on the market. It is claimed for several piano-players that they are without these so-called complicated means of expression, the expression being obtained solely by means of the feet in pedalling, as exemplified in the Simplex and Metzler F. 5 Piano-Player. It is a simple method, certainly; but so, too, are the results; and the trained musician will detect the advantage of the accentuating lever immediately.

The piano-player, truly, may be played by the most absolute novice with pleasing effect; but the ideal of the musician—the expression, the technique, the soul of the music of which the piano-player is capable—may also be obtained after careful and thoughtful practice.

When you sit down to a piano-player you take up the position of conductor for the time being; the tempo and expression are subservient to your will. Instead of waving a *bâton* you simply touch little levers, whereby you may emphasise or regulate the power or speed of any particular note or chord instantaneously.

Some piano-players are quite incapable of this minute and instantaneous alteration of the expression; on some players it is necessary to pedal for dear life for a few seconds when you wish to emphasise a particular note, and then breathlessly wait for the result, trusting to luck that the chords or notes immediately following those emphasised are not emphasised too, though they usually are. On the piano-player having levers the *fortissimo* or *pianissimo* may be obtained instantaneously by a slight movement of the fingers, and without varying the pedal in the slightest degree.

Undoubtedly the chief use and scope of the piano-player is educational. It is now, for the first time, for amateurs to make themselves acquainted with the whole of the masterpieces of pianoforte literature in the chronological order of their composition, and, through the medium of arrangements, with all the great orchestral works. The influence of this increased facility for becoming familiar with all the best music will speedily be making itself

felt in the nation. The great artists need have no fear they will be supplanted. On the contrary they will find their audiences will become larger and more appreciative. Composers will find that it will pay to write good music, and they will not have to wait long for its recognition. A generation steeped in the great classics will soon find out and appreciate good modern music.

This is why the piano-player is an educator and musical instructor, not a reproducer of simple, rudimentary music only, but capable of rendering correctly the most difficult or highly classical piece composed. It is not restricted to any particular class of music; it is equally at home with a Beethoven masterpiece as with a rollicking cake walk.

The capabilities of the piano-player are not grasped or learned in one sitting, or in twenty. As the performer becomes more practised, so constantly some new feature is revealed which adds to the pleasure of the performer, and to the technique and brilliancy of the playing. The effects obtained by a practised performer on the piano-player are almost inconceivable.

Hundreds of pianos, hitherto silent and unused, excepting as sideboards, are now echoing with the great works of Bach, Beethoven, Chopin, Schumann, Mendelssohn, and other masters. That this beneficent invention, adding so enormously to the artistic delight and intellectual enjoyment of thousands, should be discountenanced because in the hands of the unmusical and ignorant it can be rendered a positive instrument of torture, is as retrograde and illogical as the demand for suppression of motor-cars, because foreign chauffeurs and a few reckless and inconsiderate drivers and untrained horses have caused accidents and some inconvenience to the general public.

How many expensive pianos are there distributed in various drawing-rooms, so little used that they would fill their purpose equally well were they empty cases? How much is expended by parents on the musical education of their children, and with what results? A really finished performer is as rare as an oasis in the desert.

Just imagine! Try to realise! Those who cannot play a note of music; what a thrill of delight they experience in sitting down to your usually inanimate piano, out of which you have never been able to produce anything but discord, and being able to play—by your very own self, without any tutoring, without even practising—a soul-stirring piece full of expression and passion, in a manner that onl[y] few skilled musicians could equal.

Everyone is aware how difficult it is to obt[ain] a song in a specially desired key. No[w] a most important feature of the new pian[o-]player is an ingenious and easily manipula[ted] arrangement for transposing the music, whe[re-]by any song or other composition may [be] played in eight different keys without the le[ast] trouble. This desirable addition, it is alm[ost] unnecessary to explain, will prove a gr[eat] boon to all who wish to use the piano-pla[yer] as an accompanist.

Just consider the advantage this offer[s.] Some piano-players would need eight rolls [of] music to obtain the same results, as a[re] achieved on the new piano-player with a sin[gle] roll.

The Pianola and Angelus were first made [in] Meridan, Conn., at two factories situated in t[he] same street and opposite one another. T[he] Pianola was not brought before the public un[til] 1898. It had then, as now, a compass of [65] notes, and rolls were specially prepared for [it] from the pianoforte scores. The Angelus w[as] brought out a few months earlier, in 1897. [It] had 58 notes, and used organ music as pr[e-]pared for the Æolian and other instrumen[ts] of an organ nature.

The Metzler A. I. Piano-Player has be[en] invented and perfected this year, and has

1. Scale of 65 notes.
2. Transposing arrangement whereby son[gs] may be played in eight different keys.
3. Both loud and soft pedal lever.
4. Accentuating lever—for regulating t[he] expression and accentuating given notes [or] chords instantly.
5. *Tempo* lever—to regulate time.
6. Switch lever—for re-winding.
7. Transparent music cover and dust e[x]cluder.
8. Steel fingers or strikers.
9. Folding metal pedals.
10. Lock-up, folding cover, and pedal door.

There are many kinds of players on t[he] market; but, although the number of nam[es] and designs of cases are numerous and increa[s]ing each month, there are only six or eig[ht] really different varieties in constructio[n.] Piano-players are made principally in Americ[a,] but Germany is now making them, and the[re] is a factory in London.

To insert the music roll, first place t[he] rounded peg of the music spool in the sprin[g] bearing on left hand of player, press t[he] bearing inward until the notched peg on oth[er]

nd of music spool is allowed to enter the lotted bearing on right hand side of the ıstrument. Then set the Time regulator ›ver at 75, and the Switch lever at "To play;" perate the pedals, and the take-up spool will ıegin to revolve. Now take the ring on music pool and place it over the hook on the take-up pool, the music will commence to travel over he small square holes or air channels of the ıusic rest and actuate the striker fingers of he player.

The speed or time of the music is deterıined by adjusting the Time regulator lever; nd this is best and most satisfactorily ccomplished by holding the lever between the rst and second fingers of the right hand, lacing the third finger on the wood-work and sing it as a stop or rest to steady the hand nd ensure the more accurate movement of he lever.

The Expression or Accentuating lever is est worked by the thumb of the left hand, but s the pedalling is a most important factor in roducing correct expression, it is necessary o practice pedalling before attempting to make general use of the expression lever, and the ollowing instruction should be carefully noted.

Pedalling Instructions.—There are two uite distinct styles of pedalling, each of hich are equally effective if properly carried ut. In the one case the feet are placed full nd flat on the pedals, the toes about level ith the end of the pedals, and the motion is nparted from the ankles. In the other case ıe toes only are placed well forward on the edals, and the motion is obtained partly from ıe ankles and partly by raising the limbs up nd down.

The object to be aimed at is to obtain as ng and full a stroke as possible, as one long, ıll stroke of the pedal is equal to two or three hort, scratchy ones. When one or the other f these styles of pedalling has been mastered, ıe various grades of expression, the light and hade of the music, may be obtained by alterıg the length of stroke or rate of stroke of the edals; also, if only a few notes appear in the ıusic, it is only necessary to pedal very lowly; but when a number of notes appear, ıe pedal strokes must be faster and of fuller ›ngth. When obtaining the expression from ıe pedalling only, the expression lever must e set full on to the *ff.* With the expression ›ver set in this position, it is possible to obtain ›ry good results by pedalling hard or soft, as ıay be required for loud or soft passages, and sing the loud and soft pedal lever.

It must be clearly understood, however, that it is impossible to accentuate any particular notes or chord by means of the pedals, the same as may be expressed by using the expression lever. With the pedals the accentuation of any one note or chord is almost certain to be imparted more or less to the notes immediately preceding or following the note or chord required to be emphasized, so that in such cases it is absolutely necessary to use the expression lever if correct results are desired To use this lever to advantage, it is necessary to first pump up a sufficient reserve power to obtain the *ff.* and then without any variation of the pedalling, the various degrees of expression may be produced by the movement of the expression lever only. It may be mentioned that the most realistic pianistic effects are best obtained by combining the two above systems of expression, and by so doing, the expression of playing is reduced to a minimum.

The Loud and Soft pedal lever is used for the *pp* (very soft) or *ff* (very loud) passages, and when neither soft or loud pedal is required, the lever must be set in the centre between these two positions.

To Rewind.—When the end of the music roll is reached, the music paper has to be rewound on the music spool, and to effect this, the switch lever must be set full to the re-roll mark. While the music paper is being rewound, do not pedal fast, and do not allow the music paper on the take-up spool to overrun itself. Should it have a tendency to do this, press the forefinger of the left hand very gently on the outer edge of the flange of the take-up spool; judgment must be used in doing this, as if too much tension be put on, the edges of the paper are liable to be damaged. Violent pedalling when re-winding, causing the motor to work at a very high rate of speed, has a very detrimental effect on the motor, and should be sedulously avoided, also suddenly altering the switch lever from one position to the other, while the motor is being driven fast, is most injurious to the mechanism, the driving chains become stretched and loose, or are thrown off.

Adjusting the Player for 58 *and* 65-*note Music.*—To use the 58-note music in the normal key, set the transposing bearing of the music spool on right hand side of player at No. 5 position, by first raising the small flat metal stop, and taking the nickelled knob between the fingers and pushing inwards or pulling out the bearing until the No. 5 slot appears, when the small flat metal stop is

dropped into the slot to retain the bearing in that position.

The take-up spool has now to be set for the 58-note music, and to do this, first see that the switch lever is set at re-roll, then turn the spool round until the long nickelled spring—which has two holes in it only—appears on top, gently raise the spring by inserting the finger or thumb of the left hand under the extreme end, taking care not to lift the spring too high, but just sufficient to allow of the hole in the nickelled spring slipping over the stop-peg, then with the right hand, slide the spool to the right until the stop-peg comes opposite the hole on the right, when the spring should be released; next, in a similar manner, set the spring numbered plate so that the stop-peg enters the hole numbered 5; the spool is then ready for use.

When the 58-note music is being used, care must be taken to see that the position number of the music spool bearing, and the position number of take-up spool coincide, otherwise the music paper may be damaged. The two small nickelled slides on the left and right hand sides of music rest, are used in conjunction with the 58-note music paper only, as the exposed air channels are required to be covered, and care must be taken when adjusting these slides to see that they are under the music paper about 1-16th of an inch only, they must on no account be allowed to get on top.

To change the key, all that is required is to set the music spool bearing to whatever number is desired, adjust the take-up spool to same number, and then set the slides on music rest as before explained.

When using the 65-note music, set the music spool bearing at No. 1, and also the take-up spool at same number, move the two remaining portions of take-up spool to the left, and set back the left and right hand slides on music rest as far as they will go, the music may then be inserted.

To take the music spool out of the player, all that is needed is to reverse the operation of inserting the spool, and when the music roll is taken out, the music paper should be gently tightened up by gripping the roll in the middle by the left hand, and twisting the spool round by the flange with the fingers of the right hand. This will keep the music in good order, and render it less liable to atmospheric changes.

Care of the Music.—The music paper being very susceptible to dampness, care must be taken to preserve the music rolls in a d situation, otherwise the paper will expand a buckle, and when unwound off the spool w not return, being too wide; when this happe it is proof of the paper being kept in a da position, and the situation should be chang. To effect an immediate contraction of paper the roll should be unwound in front an ordinary fire, when the paper will return its normal width, and may be re-wound on the music spool.

Height of Seat.—It is of the greatest i portance that the seat used when playing be least 26 inches high. This will enable th operator to work the pedals with greater fir ness and at the same time make the operati of pedalling much easier. Satisfactory resu cannot be obtained when using a low seat.

The Care of the Piano-player.—It m be kept in a dry place, its mechanism bei more susceptible to atmospheric influenc than a piano. Often a piano is situated in room where fires are rarely lighted, and t action becomes stiff, but the piano-player und similar conditions is likely to be more inju iously affected.

The piano-player too must be periodica lubricated. Invariably a piano-player has much work in the first few months after pu chase, as a piano would have in the ordina way in the same number of years; it is, ther fore, imperatively necessary to oil or grea the frictional parts of the motor and drivin gear especially, and the slides of the mot must be kept well lubricated with very fi powdered dry blacklead. If these precautio are neglected and the face of the motor of th slides become worn, the regular working the motor is seriously affected.

Great care must be taken that no foreig substances ever enter the air ducts or channel

In my opinion there is a great future f piano-players, and Mr. Ashton Johnson, his very able paper, entitled "Music an Mechanism," says:—

"I daresay that at first sight my ideas upon th influence of the piano-player on the future of mu may seem to some of my readers exaggerated, but am convinced that with the present stirring of d bones in the educational world there will com increased appreciation of the powerful factor th music is an education.

"The life of the teacher of music will be agreeab diversified. He will find that he has only to teac the drudgery of technique to keen and eager pupil whilst for those who, for one reason or another, d not wish to become technically proficient, his teac

g will take the shape of musical lectures, which he n illustrate to his heart's content on the piano-ayer. How it simplifies and encourages the learng of new music by amateurs of limited technique ust be experienced to be appreciated."

Also, "give me," wrote Mr. G. Bernard haw in 1894, while discussing "The Religion the Pianoforte," "give me a fingering meianism so contrived as to be well under the rtistic control of the operator, and I will make n end of Paderewski." He has asked for it, nd if, in the language of the advertisement, e has got it, I hope he is now happy. But he not abolishing Paderewski, nor indeed any ther artist worthy of the name. He is cerinly assisting at the annihilation of all ianists whose sole claim to distinction is a iore or less perfect technique, unsupported by itellectual, poetic, or emotional inspiration.

Again, at an afternoon recital at Bechstein [all last season, I counted in the gallery lone, four men, who, to my personal knowdge, had left the City to hear Godowsky lay Chopin's "Fantasia" and Beethoven's Appassionata," in order that they might ish home and imitate his readings on their cently purchased piano-players.

In conclusion, properly used, the pianolayer must enormously simplify and aid a ue musical education, and with the aid of aluable patents and increased facilities for ianufacture, piano-players can be had at ices to suit everybody's pocket, but I lay ress upon the fact that in the selection of a iano-player discrimination must be used, and iyone who can appreciate the artistic work a good pianoforte will understand the value a high grade piano-player.

[In illustration of the subject of the paper, three iano-Players were shown, which were operated upon Mr. Knightley and Mr. Coward. Miss Teresa lamy sang a song with an accompaniment on the iano-Player. Mr. Ffrangcon-Davies also sang Sir rederick Bridge's new song "The England of Toorrow," words by T. W. Wheeler, K.C., and was companied by the Chairman.]

DISCUSSION.

The CHAIRMAN said the examples of mechanical ayers which they had before them, and the performices of Mr. Knightley on the machine, had given ie meeting a great deal of pleasure, and he thought iat many persons in the audience had been conderably surprised. They had heard a piece of Beethoven played without any wrong notes, and as they must admit, a most remarkable amount of expression. He did think that the piece wanted a little bit more of the real expression, but still there had been a great deal of expression in the way in which it was played, and a great deal more than was got from the playing of a young lady who practised two or three hours a day to the detriment of her health, and the neglect of her general education. Then they heard an accompaniment played upon the instrument, and the singer was allowed to sing the song with just as much expression as she thought fit to put into it; and as far as he could judge the piece was accompanied by Mr. Coward so well, that if he had not been looking at the instrument he should not have known that Mr. Coward was not playing in the ordinary way with his fingers. He did not think that there had been much to complain of in that accompaniment. At any rate it was better than was got ordinarily from a young lady in a drawing-room, when asked to accompany a song. It would be a perfect blessing to many people if they were able to have a song with an accompaniment played in a decent way. This would no doubt be a tremendous gain; so it was impossible to gainsay the fact that the machine might be extremely useful, and would supply a genuine want. It would enable people to play classical music which they could not hope to play at all fairly with their hands, and it would enable them to have a properly played accompaniment to a song. There was no doubt that those things were not possible in the ordinary state of musical education. Many people could be found to play classical pieces fairly well, but there were very few people who could play the accompaniment to a simple song. This showed that there must be something wrong in the way that pianists and children at school were being educated. The power to read a simple piece of music such as the accompaniment of an ordinary song, was hardly to be found, and yet some people could sit down and play half a dozen extremely difficult pieces such as ballades of Chopin and sonatas by Beethoven. He had heard this admirably done by children, and he had given the same children a small piece from an album, and they had been unable to read it. To be able to play the difficult pieces without being able to read the simple ones, was not being a musician, it was being a machine. He would rather buy a machine than have his child turned into a machine. One of the things that the inventors and advocates of the machine for playing the piano ought to be most proud about, was the fact that they had got the machine into such a position that it demanded from the performer the exercise of his own brain. It was not a thing where they had simply to turn on a tap, so that they could sit down and smoke while they listened. That had been done many years ago. But here was an instrument into which the performer could put his own musical feeling if he had any. This was a fact

which made the machine worth considering, because if people had been taught to play on the wrong system—and, of course, they all found out when they went to a new teacher, that they had been taught to play on the wrong system—they could make use of one of the mechanical players, and do all the work with two or three fingers and their feet. As to the need for brains, he was not sure that they did not need more brains to use this complicated machinery than to make their fingers and thumbs work properly in ordinary playing. But though they needed brains for machine playing, they were not obliged to have a bushy head of hair, for the machine did not give them any opportunity to roll about, and that was a blessing. The instrument had many advantages. He wished to record his very high appreciation of the lucid way in which Mr. Coward had put it before them, and of the admirable way in which Mr. Knightley had applied the machine to the music. Mr. Coward also had admirably played an accompaniment by means of the machine, although he was not a practised performer with that appliance. That was encouraging, because if he could do it some of the audience could do it too. The general result of the evening had been a surprise of great interest to him, and he was sure that there was no reason why the invention should not be an immense factor in the spread of really good music. That was one of the great conveniences of it. He remembered going into a room one day while he was staying at a country house, and seeing some ladies listening to another lady performing on a mechanical player. He could see by the expression on their faces that they were listening to a great classical piece. He could not make out the music. It sounded very abstruse, and he felt that he was hardly educated up to it, though occasionally he seemed to recognise it. He whispered to one of the ladies, "What is it?" and the answer was "Bach's Fugue in D Minor." But he discovered that it was being played backwards, for the perforated paper had been put in upside down. He had never repeated this experience in public since, but it was a perfectly true one, and it was very amusing, and did no harm to the instrument. One of the recommendations of these machines was that they enabled a person to play anything he liked either forwards or backwards.

In answer to some questions,

Mr. Coward gave further explanations with regard to the mechanical players. He said that he had never seen one of the rolls of paper perforated, but he could state that the perforated roll was not produced by a person on a musical instrument and in that way producing the perforations. The stencil was cut by hand first of all. The explanations which he had given in his paper as to the way in which the machine was prepared for use would apply in the main to all the machines, but some of the machines were developed further than others, and possessed additional features which other did not possess. As to the possibility of constructin a machine which would be sympathetic and responsiv to the performer without having so many levers an things which could get out of order, he did not kno what might be made in future. Good expressic could be got from the machine in which the expres sion was produced by means of the pedals withou the accentuating lever.

A vote of thanks was unanimously accorded Mr. Coward.

Miscellaneous.

GERMAN MINERAL OIL INDUSTRY.

The following particulars of the production mineral oil in Germany, taken from the *Board Trade Journal*, are extracted from a despatc to the Foreign Office from H.M. Consul-General Hamburg :—

The localities where mineral oil was found as lon ago as the 12th century, and where the same wel mostly still exist, are situated on a line—the so-calle "oil-line"—extending from Verden to Brunswic the most noteworthy places being Wietze, Stei förde, Oberg, Oelsburg, Oelheim, and others.

With regard to the depth that has to be reached order to find oil, the so-called first "oil horizon" found at Wietze at a depth of between 130 to 1 feet, and in other localities at a somewhat great depth. When the oil at this depth is exhauste deeper borings have to be made. In Galicia second "oil horizon" is often found at a depth 656 to 984 feet; and still deeper borings, viz., to 1,9 and even to 2,850 feet, have been made there, and ha struck very productive oil beds. In Galicia, indee experts are stated to be all of the opinion that t deeper the borings the better are the results as regar oil.

It is stated that there are many distinct sig pointing to the widespread presence of oil in t Province of Hanover, and that it might be conclud that at least 80 million barrels of mineral oil were be found there. Up to the present the total produ tion has, it is stated, reached about five to six thousa tons only per annum; but a very considerable i crease in the annual yield is looked forward to f the future.

The quality of the mineral oil found at Wiet differs according to the different boreholes whence is taken; and also according to the depth at whi the oil is found. The oil is of two kinds, viz., eith of a heavy, or of a lighter sort. The latter is present found at the greatest depths. The heavy is of a brownish-black colour, and quite thick, a

s more like tar than like petroleum; it contains ɛr cent. of benzine, 10 per cent. of petroleum, ıt 60 per cent. of lubricating oil, and 20 per cent. ar. The lighter oil contains about 4 per cent. of zine, 25 to 30 per cent. of petroleum, 45 per cent. :line oils, and 10 per cent. of tar (or goudron).

,arge refinery works are at present being erected at den, near Hanover, for distilling the mineral oils duced chiefly at Wietze.

t may be observed that almost the entire quantity lubricating oil required by the German railway ıpanies for greasing purposes, is supplied by the etze oil wells.

Correspondence.

THE MINING OF NON-METALLIC MINERALS.

[have read with much interest the papers which ɛe recently appeared in your journal by Mr. Bennett Brough, and I wish to correct an erroneous im- ɛssion as to the occurrence of manjak (bitumen) ly in infusorial earth in Barbados.

The island is covered in isolated spots over one- ɛnth of its area, where coral limestone does not pear, with infusorial earth. But this deposit is ly superficial, and manjak is being mined at some pth below the base of this earth, in greyish-blue ıys intermixed with argillaceous sands.

The whole formation in this district (called the otland district of Barbados, owing to a similarity ıich some early settlers from the Mother Country w to the hills of their own Scotland) is very much oken and distorted by volcanic upheaval (of some rly date), and small quantities of oil have been uck in several spots in the manjak area by an ıglish company now operating.

Mr. Brough also refers to "Albertite" of United ates of America, but does not mention "Gilsonite" Colorado-Utah, which is much more extensively ned and better known. In fact, I doubt if Albertite" is being mined at all to-day.

It is to be regretted that so many merely local mes have been given to the same mineral, as it ıds to confusion. But, no doubt, time will correct s confusion caused by a more or less laudable sire on the part of every prospector to hand down ; name to posterity.

Mr. Brough also refers to Egyptian asphaltum as ough it were still an article of commerce. From all :an learn about it, a sample can hardly be obtained London to-day; and the bitumen which has taken place for highest grade varnishes, &c., is that m Turkey, and the highest grade of Barbados.

R. H. EMTAGE.

4, James-street,
Bridgetown, Barbados,
February 12th, 1904.

Obituary.

SIR JOHN SCOTT, K.C.M.G., D.C.L.—Sir John Scott, who died at Norwood, on the night of the 1st inst., was a member of the Society of Arts, and read two papers before the Indian Section on the results of his work in Egypt. The first on "Judicial Reform in Egypt and India," was read at a meeting on April 27th, 1899, at which the late Lord Russell, then Lord Chief Justice of England, presided. For this paper the author received the Silver Medal of th Society. The second paper, on "English and Anglo-Indian Criminal Procedure, a Comparison," was read on May 24th, 1900.

Sir John Scott was the son of a solicitor, and was born at Wigan, in 1841. He was educated at Bruce Castle School, Tottenham, under Frederick Hill, brother of Sir Rowland Hill, the founder of the school, and at Pembroke College, Oxford, where he graduated in 1865. He was captain of his college eleven, and played for his University against Cambridge in 1863. He was called to the bar at the Inner Temple in 1865, and joined the northern circuit. On account of ill-health he went to Egypt in 1872, and practised in the British Consular Court. Subsequently he became British representative on the new International Courts of Appeal, and in 1882 he became a Judge of the High Court of Bombay. In 1890 he was appointed Judicial Adviser to the Khedive, an office which he held until 1898, when he returned to England, and was appointed Deputy Judge Advocate-General. In the obituary notice of Sir John Scott in the *Times*, he is said to be known by the natives of Upper Egypt as "Scott the Just."

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock:—

MARCH 16.—"Artificial and other Building Stones." By L. P. FORD. PROFESSOR J. M. THOMSON, L.L.D., F.R.S., will preside.

MARCH 23.—"The Rural Housing Question." By T. BRICE PHILLIPS. The LORD BELHAVEN AND STENTON will preside.

Dates to be hereafter announced:—

"Lessons to be Learnt from the Fire Brigade Appliances at the late International Fire Exhibition." By EDWIN O. SACHS.

"Early Painting in Miniature." By RICHARD R. HOLMES, C.V.O.

"Agricultural Education." By J. C. MEDD.

"Motor Cars for popular use." By MERVYN O'GORMAN, M.Inst.E.E.

"Statistics of the World's Iron and Steel Industries." By WILLIAM POLLARD DIGBY.

"The Need of Duty Free Spirit." By THOMAS TYRER.

Indian Section.

Afternoons, at 4.30 o'clock :—

THURSDAY, MAY 12.—"British-Grown Tea." By A. G. STANTON.

TUESDAY, MAY 31.—"The Economic and Industrial Progress and Condition of India." By J. E. O'CONOR, C.I.E., late Director-General of Statistics, India.

Colonial Section.

Tuesday afternoons, at 4.30 o'clock :—

MARCH 22.—"Cotton Growing in the British Empire." By ALFRED EMMOTT, M.P. THE RIGHT HON. SIR EDWARD GREY, BART., M.P., will preside.

APRIL 12.—"The Regeneration of South Africa." By BEN. H. MORGAN.

MAY 3.—"Canada and Great Britain." By W. L. GRIFFITH.

Applied Art Section.

Tuesdays, at 4.30 or 8 o'clock :—

MARCH 15, 4.30 p.m.—"Recent Developments in Devonshire Lace-making." By ALAN S. COLE, C.B.

APRIL 19.—"The Sentiment of Decoration." By ALFRED EAST, A.R.A.

MAY 17.—"Pewter." By LASENBY LIBERTY. SIR GEORGE BIRDWOOD, K.C.I.E., C.S.I., will preside.

Cantor Lectures.

Monday evenings, at 8 o'clock :—

BERTRAM BLOUNT, F.I.C., "Recent Advances in Electro-Chemistry." Three Lectures.

LECTURE II.—MARCH 14.—Preparation of metals from fused electrolytes, zinc, aluminium, and sodium—Non-metallic products obtainable electro-chemically—Alkali and bleach, hypochlorites, chlorates—Hydrogen, baryta, nitric acid—Organic substances.

LECTURE III.—MARCH 21.—The electric furnace—Calcium carbide, carborundum, graphite, fused quartz—Carbon disulphide—Phosphorus, iron.

The following course will be delivered on Monday afternoons, at 4.30 o'clock :—

PROF. R. LANGTON DOUGLAS, M.A., "The Majolica and Glazed Earthenware of Tuscany." Three Lectures.

April 25, May 2, 9.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, MARCH 14...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. Bertram Blount, "Recent Advances in Electro-Chemistry." (Lecture II.)

British Architects, 9, Conduit-street, W. 8 p.m. Mr. J. D. Crace, "Plaster Decoration."

Medical, 11, Chandos-street, W., 8½ p.m.

TUESDAY, MARCH 15...SOCIETY OF ARTS, John-street, Adelphi, W.C., 4½ p.m. (Applied Art Section.) Mr. Alan S. Cole, "Recent Developments in Devonshire Lace-making."

Royal Institution, Albemarle-street, W., 5 p.m. Mr. L. A. Wallis Budge, "The Doctrine of Heaven and Hell in Ancient Egypt, and the Books of the Under World." (Lecture I.)

Civil Engineers, 25, Great George-street, S.W., 8 p.m. 1. Mr. G. H. Stephens, "The Barrage across the Nile at Asyut." 2. Sir Robert H. Brown, "The use of Cement Grout at the [illegible] Barrage in Egypt."

Statistical, 9, Adelphi-terrace, W.C., 5 p.m. Mr. Edgar J. Harper, "Statistics of London Traffic."

Pathological, 20, Hanover-square, W., 8½ p.m.

Zoological, 3, Hanover-square, W., 8½ p.m. 1. Mr. F. E. Beddard, "Contributions to the Anatomy of the Lacertilia.—I. On the Venous System in certain Lizards." Mr R. Lydekker, "Skull and Markings of the Quagga." 3. Mr. P. I. La[illegible], "Additions to the List of Rhopalocera of Dominica."

Colonial Institution, Whitehall-rooms, Whitehall-place, S.W., 8 p.m. Mr. J. G. Colmer, "Notes on some Canadian Problems."

WEDNESDAY, MARCH 16...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. L. P. F[illegible], "Artificial and other Building Stones."

Meteorological, 25, Great George-street, S.W., [illegible] p.m. Mr. Richard H. Curtis, "Water Vapour."

Chemical, Burlington-house, W., 5½ p.m. 1. [illegible] P. C. Ray, "Mercuric nitrite and its decomposition by heat." 2. Mr. J. B. Hannay, "Note on the higher glycerides." 3. Messrs. C. H. Bur[illegible] and D. L. Chapman, "The nature of a solution of iodine in aqueous potassium iodide." 4. Messrs. J. B. Cohen and J. Marshall, "The reduction of 2 : 6 dinitrotoluence with hydrogen sulphide." [illegible] Messrs. F. D. Chattaway and W. H. Le[illegible], "Isomeric change of diacylanilides into [illegible] amino kotones." 6. Messrs. W. A. Bone, J. [illegible] Sudborough, and C. H. G. Sprankling, "[illegible] esters of methyl substituted succinic acids."

Microscopical, 20, Hanover-square, 8 p.m.

British Archæological Association, 32, Sackville-street, W., 8 p.m.

THURSDAY, MARCH 17...Aeronautical (at the HOUSE OF THE SOCIETY OF ARTS,), John-street, Adelphi, W.C., 8 p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Royal, Burlington-house, W., 4½ p.m.

Linnean, Burlington-house, W., 8 p.m. 1. Mr. [illegible] W. Wat rs, "The Bryozoa from Franz Josef Land." 2. Mr. Enoch, "Natural-Colour Photographs of Living Insects and Flowers."

Royal Institution, Albemarle-street, W., 5 p.m. Dr. Sidney Lee, "Shakespeare as his Contemporaries knew him." (Lecture I.)

Optical, 20, Hanover-square, W., 8 p.m. Discussion on "Report of the Optical Standard Committee."

Historical, Clifford's Inn Hall, Fleet-street, E.C., 5 p.m.

Numismatic, 22, Albemarle-street, W., 7 p.m.

Mining and Metallurgy, Geological Society's Rooms, Burlington-house, W., 8 p.m. Discussion on "The Equipment of Laboratories for Advanced Teaching and Research in the Mineral Industries."

FRIDAY, MARCH 18...United Service Institution, Whitehall, S.W., 3 p.m. Dr. T. Miller Maguire, The N[illegible] Pacific from a Strategic Point of View."

Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting, 9 p.m. Mr. Henry Arthur Jones, "The Foundation of a National Drama."

Quekett Microscopical Club, 20, Hanover-square, W.C., 8 p.m.

Mechanical Engineers, Storey's-gate, Westminster, S.W., 8 p.m. M. Edouard Sauvage, "Compound Locomotives in France."

SATURDAY, MARCH 19...Royal Institution, Albemarle-street, W., 3 p.m. Lord Rayleigh, "The Life and Work of Stokes." (Lecture V.)

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FRIDAY, MARCH 18, 1904.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

NEXT WEEK.

Monday, March 21, 8 p.m. (Cantor Lecture.) Bertram Blount, F.I.C., "Recent Advances in Electro-Chemistry." (Lecture III.)

Tuesday, March 22, 4.30 p.m. (Colonial Section.) Alfred Emmott, M.P., "Cotton-Growing in the British Empire."

Wednesday, March 23, 8 p.m. (Ordinary Meeting.) T. Brice Phillips, "The Rural Housing Question."

CANTOR LECTURES.

On Monday evening, 14th inst., Mr. Bertram Blount, F.I.C., delivered the second lecture of his course on "Recent Advances in Electro-Chemistry."

APPLIED ART SECTION.

Tuesday afternoon, March 15, 1904; Sir George Birdwood, K.C.I.E., C.S.I., Vice-President of the Society, in the chair.

The paper read was "Recent Developments in Devonshire Lace-making," by Alan S. Cole, C.B.

SOCIETY OF ARTS MAP OF THE WORLD.

A map of the world has been prepared, showing the principal places outside the United Kingdom, in which members reside, and to which the Society's *Journal* is sent. The map has been produced by Messrs. George Philip & Son, Ltd., and indicates the principal steamship tracks, through lines of railways, principal naval and coaling stations, and the distances between the chief ports of the world. A copy of the map will be forwarded, post free, to any member who likes to apply to the Society's advertisement agents, Messrs. Walter Judd, Ltd., 5, Queen Victoria street, London, E.C.

THE ALBERT MEDAL.

The Council will proceed to consider the award of the Albert Medal for 1904 early in May next, and they, therefore, invite members of the Society to forward to the Secretary, on or before the 5th of April, the names of such men of high distinction as they may think worthy of this honour. The medal was struck to reward "distinguished merit in promoting Arts, Manufactures, and Commerce," and has been awarded as follows in previous years :—

In 1864, to Sir Rowland Hill, K.C.B., F.R.S.

In 1865, to his Imperial Majesty, Napoleon III.

In 1866, to Michael Faraday, D.C.L., F.R.S.

In 1867, to Mr. (afterwards Sir) W. Fothergill Cooke and Professor (afterwards Sir) Charles Wheatstone, F.R.S.

In 1868, to Mr. (afterwards Sir) Joseph Whitworth, LL.D., F.R.S.

In 1869, to Baron Justus von Liebig, Associate of the Institute of France, For.Memb.R.S., Chevalier of the Legion of Honour, &c.

In 1870, to Vicomte Ferdinand de Lesseps, Member of the Institute of France, Hon. G.C.S.I.

In 1871, to Mr. (afterwards Sir) Henry Cole, K.C.B.

In 1872, to Mr. (afterwards Sir) Henry Bessemer, F.R.S.

In 1873, to Michel Eugène Chevreul, For.Memb. R.S., Member of the Institute of France.

In 1874, to Mr. (afterwards Sir) C. W. Siemens, D.C.L., F.R.S.

In 1875, to Michel Chevalier.

In 1876, to Sir George B. Airy, K.C.B., F.R.S., Astronomer Royal.

In 1877, to Jean Baptiste Dumas, For.Memb.R.S., Member of the Institute of France.

In 1878, to Sir Wm. G. Armstrong (afterwards Lord Armstrong), C.B., D.C.L., F.R.S.

In 1879, to Sir William Thomson (now Lord Kelvin), LL.D., D.C.L., F.R.S.

In 1880, to James Prescott Joule, LL.D., D.C.L., F.R.S.

In 1881, to August Wilhelm Hofmann, M.D., LL.D., F.R.S.

In 1882, to Louis Pasteur, Member of the Institute of France, For. Memb. R.S.

In 1883, to Sir Joseph Dalton Hooker, K.C.S.I., C.B., M.D., D.C.L., LL.D., F.R.S.

In 1884, to Captain James Buchanan Eads.

In 1885, to Mr. (afterwards Sir) Henry Doulton.

In 1886, to Samuel Cunliffe Lister (now Lord Masham).

In 1887, to Her Majesty Queen Victoria.

In 1888, to Professor Hermann Louis Helmholtz, For. Memb. R.S.

In 1889, to John Percy, LL.D., F.R.S.

In 1890, to William Henry Perkin, F.R.S

In 1891, to Sir Frederick Abel, Bart., G.C.V.O., K.C.B., D.C.L., D.Sc., F.R.S.

In 1892, to Thomas Alva Edison.

In 1893, to Sir John Bennet Lawes, Bart., F.R.S., and Sir Henry Gilbert, Ph.D., F.R.S.

In 1894, to Sir Joseph (now Lord) Lister, F.R.S.

In 1895, to Sir Isaac Lowthian Bell, Bart., F.R.S.

In 1896, to Prof. David Edward Hughes, F.R.S.

In 1897, to George James Symons, F.R.S.

In 1898, to Professor Robert Wilhelm Bunsen, M.D., For. Memb. R.S.

In 1899, to Sir William Crookes, F.R.S.

In 1900, to Henry Wilde, F.R.S.

In 1901, to His Majesty the King.

In 1902, to Professor Alexander Graham Bell.

In 1903, to Sir Charles Augustus Hartley, K.C.M.G.

A full list of the services for which the medals were awarded was given in the last number of the *Journal*.

Proceedings of the Society.

COLONIAL SECTION.

Tuesday afternoon, March 1, 1904; The Duke of Marlborough, K.G., Under Secretary of State for the Colonies, in the chair.

The paper read was—

NIGERIA.

By Lady Lugard.

I speak this afternoon before an audience which is new to me, but the subject upon which I have been asked to speak is one of such limited general interest as yet that I believe I shall not be very far wrong if I assume that, with a few notable exceptions, your knowledge of it is not much greater than my own was a very few years ago. I have had special reasons for learning something more about it since then, but there are other and more public reasons why you should have gathered in this hall to-day to listen to a paper read about a place of which five or six years ago you had probably not heard the name.

That you are here for such a purpose is in my opinion an indication of a very marked change which is taking place in the development of Colonial and Imperial questions. Interest in the colonies has now for some years been general, but the principal current of interest has been directed—chiefly no doubt along the channels of trade and emigration—to the great self-governing colonies. It is in the development of Australasia, of Canada, and above all of South Africa that public interest has been so keenly awakened. But the new current of which I speak, and to the growing strength of which I take your presence here to testify, is a perception of the great importance to us as a nation of the wise and active development of our tropical dependencies. I think our next colonial chapter will be a tropical chapter. These tropical dependencies are vast fields of potential wealth. They may become under judicious administration valuable markets of supply for raw material and markets of consumption for manufactured goods. So long as they are industrially neglected they represent, as Sir Robert Schomberg said fifty years ago of British Guiana, merely "buried riches." But the impulse may come at any moment to dig up these buried riches. We want new markets. They lie ready to our hand. A great new development of wealth depends upon their administration and upon the knowledge of their resources, which may become common, not only to the British people, but to other European peoples, our competitors in the industrial race. That interest in their resources is awakening is, I think, no longer to be doubted. It will bring in its train shortly a number of stirring questions, on which the happiness, and it may be said the place in history of millions of subject peoples may depend. I have only to remind you in this connection that we are an Empire of 413 millions of people, and that of 413 only 52 millions are white. What we, who are the ruling factor, decide as to the methods by which the fate of the others shall be controlled is obviously among the important processes of Imperial development.

It is a curious side of these questions—I venture to think not always an unfortunate side—that many of our decisions upon them are made almost unconsciously. Those who are at the head of affairs do but translate the nation's mind to the best of their comprehension. They are necessarily governed by the state of public opinion, and by a thousand other conditions independent of themselves, which are too numerous to name. The state of opinion which made it possible for England to accept under the Treaty of Utrecht, a contract for the supply of slaves to Spanish America has entirely passed away; the state of opinion

which, to take a nearer instance, made it possible little more than 50 years ago to give self-governing institutions to our great white colonies, in the expectation that they would use the institutions for the purpose of separating themselves from Great Britain, and thus laid for us in pure unconsciousness the foundation of that freedom upon which our Empire has been so securely built, has no less disappeared. We have learned from the fruits of it the value of the liberty which we gave, but we did not give it with far-sighted deliberate intention. It was given because, on the whole, in the swaying to and fro of public opinion the strongest bias was in favour of granting to our fellow Englishmen of the colonies the freedom of self-government which they had exercised at home—a more or less blind public instinct was the dynamic force. Now,—in our capacity of public,—we are not responsible for conscious statesmanship, but we are responsible for that unconscious part of statesmanship, which proceeds from the general standard of opinion. And the only way in which I think we can form opinions of any value is by allowing ourselves also to go through the unconscious process of having them, as far as possible, formed for us by facts. Most of us are very ignorant in regard to tropical colonies and to tropical questions. If tropical administration is going to form, as I believe it is, a new and interesting chapter in the near future of Imperial development, then perhaps the best that we as part of the common public can do is to set ourselves to learn some ordinary facts about the tropics. This is my excuse for addressing you to-day. This, I believe—whether you know it or not—your reason for coming to hear me.

It brings me back to my facts, and I will ask you to forgive me if in the case of this very new tropical possession, I begin too simply at the beginning.

I think you all know that within the last few years a number of native States in the interior of the Western Soudan have been added to the British Empire. It was Sir George Taubman Goldie, the founder of the Royal Niger Company, who first perceived the possible value of these States to us, and who in the race of European nations for Africa reserved this large share for Great Britain. He made commercial treaties in the manner rendered classic to Engish history by the East India Company, with the many chiefs who ruled the countries on the borders of the Niger and the Benue. In consequence of his exertions, a British Protectorate over them was declared, of which the limits extend to the latitude of Lake Chad in the north, a distance of upwards of 800 miles from the sea, and to the lines which now form the German position on the east, and the French position on the west of the great watershed of the Lower Niger and the Benue. I have been so often asked where it is that I may perhaps be pardoned for pointing out that the Lower Niger and the Benue flowing together at Lokoja, about 250 miles from the sea, form the irregular figure of a large letter Y, which stands upon the northern coast of the Gulf of Guinea. You have to think of the whole territory as running north and south, not east and west, from the sea.

This territory is not politically one. It is a congeries of many States, inhabited by widely differing native races. Its native names are many. But for convenience of English description it received, on its incorporation with the Empire, the collective English name of Nigeria. When the name was first given to it it was still the territory of the Chartered Company, and it extended inland about 800 miles from the sea at the northern shore of the Gulf of Guinea to the line which forms its northern frontier between Lake Chad and the Niger. But the company had not been able to extend any system of administration into the northern portion of the territory. Indeed there were many portions into which they had not been able to enter, and in which their treaty rights remained necessarily theoretic, and it was found desirable, when the frontiers with foreign neighbours had been clearly defined, to transfer the territory to the direct administration of the Crown. The Royal Niger Company relinquished its charter on the 1st January, 1900. The territory, together with that of another British Protectorate, on the coast, was redivided, under the names of Southern and Northern Nigeria. It now, with that other territory, forms two Governments, a coast Protectorate which, under the name of Southern Nigeria, stretches for upwards of 100 miles in a strip along the coast, and an inland Protectorate with no sea line which, under the name of Northern Nigeria, extends from the borders of Southern Nigeria and Lagos, into the relatively healthy uplands bordering on the Sahara, and comprises within its limits an area of one-third the size of British India.

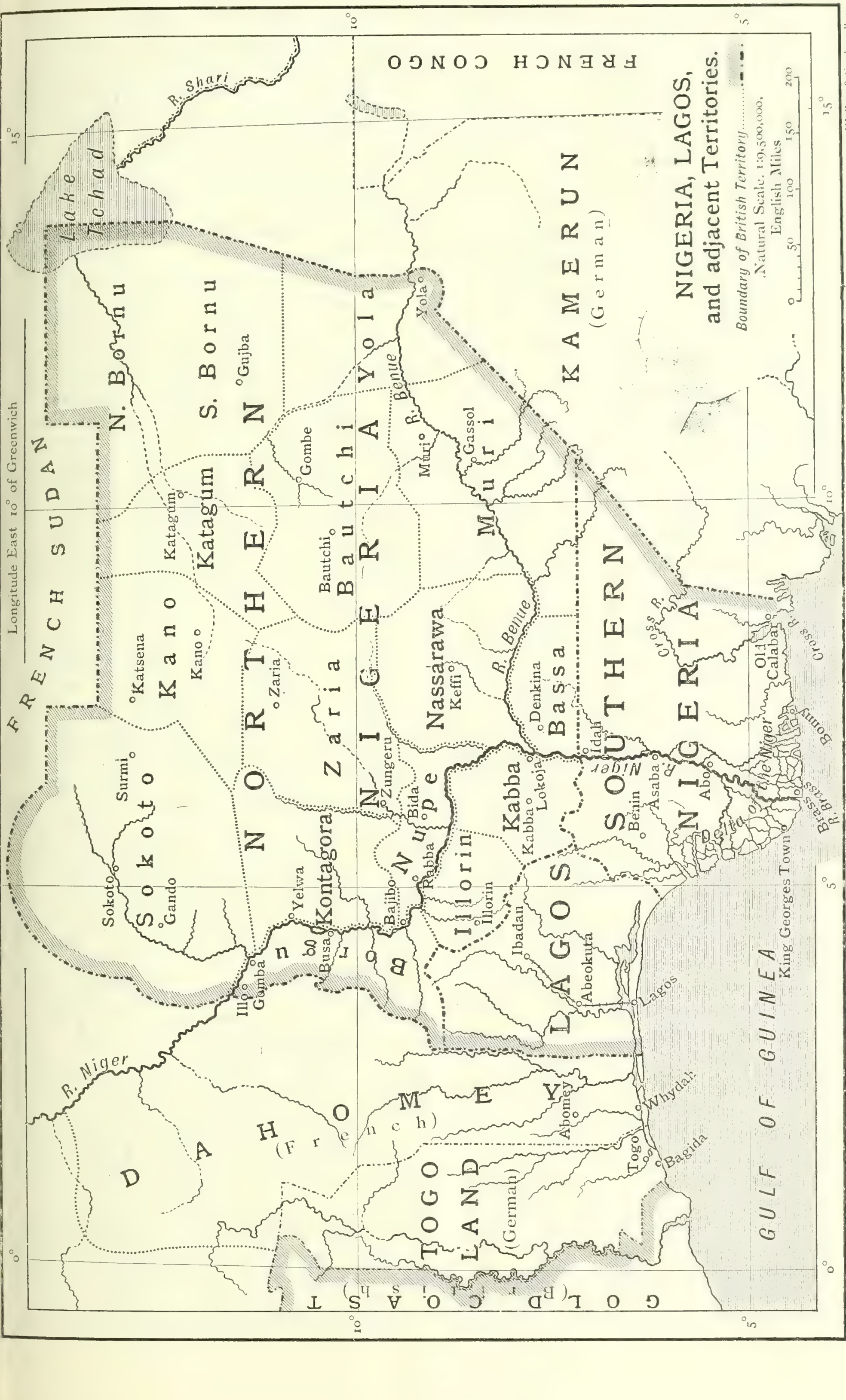
The whole territory, brought into the Empire by the operations of the company, extended

over an area of about 500,000 square miles. To have secured this for the nation is not a small thing for a body of private gentlemen to have done. The East India Company had existed for upwards of 200 years before its territories were transferred to the British Crown. Successive generations assisted in the work that it achieved. This company existed as a political body for only 20 years—a working chapter in one man's life—but in that short time it set a mark on history which posterity cannot forget.

I have spoken of the size of the country as being one-third that of India, and I have purposely compared it with that great dependency. There are many points which are strikingly parallel in the history of Nigeria and of India. To begin with, from our own point of view, it has been said of India that it is only a geographical expression. There is no historic entity which can properly be described as India. It is an agglomeration of countries and of peoples which Great Britain has agreed to bind together under one title. This is equally true of Nigeria. In India, before the coming of Europeans, native races of a lower order than the present ruling castes allowed themselves to be driven by successive invasions down to the sea shores of the extreme south, or up into the wild fastnesses of the hills. It is equally true of Nigeria. There the pagan races of some very low, some very hardy, types have been driven by natîve conquerors either towards the coast, where in Southern Nigeria they may be seen in a condition not far removed from the primitive nudity of the forest apes, or into mountain fastnesses, where they still triumphantly hold their own alike against the justice and the injustice of existing rule. In India the great native invasions were ever from the north. They each in turn established religious and military dominations over the peoples that they found. Each in turn was regarded as invincible, till from the sea and from the south there came a power, small in number, but great in strength, which overthrew them all and organised the shattered dominions for prosperous development under the freedom of civilised institutions. So it has been with Nigeria. There are traditions of her history for upwards of a thousand years, and for the greater part of that time her experience has been that of India, the rich and the civilised tempting spoliation by the strong, weakness and corruption gradually undermining manly virtue, and successive waves of invasion, ever from the north, till England has advanced again from the sea and from the south. As in India so in Nigeria. We meant to trade but conquest was forced upon us. Having conquered we are now obliged to administer, and the hope that lies before us is to develop from the small beginnings which have been made in Nigeria such another grea and prosperous dominion as our ancestors have created for us in India.

When my husband, Sir Frederick Lugard took up the High Commissionership on th 1st of January, 1900, he and his little handful of civil and military officials looked roun them at just such a position as Englishme have seen themselves called upon to deal wit again and again in the three hundred year during which our Empire has been made They were, I forget how many, but an in finitesimally small number. (The number o white men including non-commissioned officer and civil subordinates now in the country aver aged last year only 165.) They had at their ser vice a small force of native soldiers which the had themselves organised and trained to figh admirably under white leadership. In Nigeri so far this force has proved as invincible a Clive's best levies. They numbered among themselves some of the very best types Englishmen of all ranks, men loving adven ture, devoted to their work, accustomed to th hard exercise of sport and war, and carryin with them into all they did the inexpressib advantage of having been bred in the fair an kind habits of our public schools and home This fairness and kindness in dealing wi native questions and with the individual nativ themselves has, perhaps, had more to do wi the rapidity and completeness with which o administration has been established in Niger than any other single quality. Without brain initiative, and decision it would, however, ha been insufficient. These qualities were n wanting.

Nobody, I think, can imagine without havi actually seen men under these conditions work what a school for the development character a new country like Nigeria is. Fro the High Commissioner down to the lowe subordinate, every white man is in a positi of authority, and every white man owes it himself and to his country to maintain t dignity of the place in which he finds himse There are black sheep, of course; but, spea ing generally, the larger atmosphere patriotism is all round personal life. M grow to be of greater mind with the grea


NIGERIA, LAGOS,
and adjacent Territories.
Boundary of British Territory
Natural Scale. 1:9,500,000.
English Miles
0 50 100 150 200
Longitude East 10° of Greenwich
Walker & Cockerell sc.
FRENCH SUDAN
FRENCH CONGO
KAMERUN
(German)
NORTHERN NIGERIA
SOUTHERN NIGERIA
LAGOS
DAHOMEY
(French)
TOGO LAND
(German)
GOLD COAST
(Brit.)
GULF OF GUINEA
Lake Tchad
R. Shari
R. Niger
R. Benue
Cross R.
Delta of the Niger
N. Bornu
S. Bornu
Sokoto
Kano
Katagum
Bautchi
Yola
Zaria
Nassarawa
Muri
Kontagora
Nupe
Borgu
Ilorin
Kabba
Bassa
Gujba
Gombe
Katsena
Surmi
Gando
Yelwa
Busa
Gomba
Illo
Bajibo
Rabba
Bida
Zungeru
Keffi
Denkina
Lokoja
Idah
Benin
Asaba
Abo
Gassol
Ibadan
Abeokuta
Lagos
Whydah
Abomey
Togo
Bagida
King Georges Town
Old Calabar
Bonny R.
Brass R.
Cross R.

work they have to do. To me, this effect of the life upon the men is very striking, and I think you will agree with me that it is among the most valuable effects of Empire.

For the little band of Englishmen in Nigeria at the beginning of the year 1900 there was work enough to do. The country which resembled India in so many other respects resembled it also in this, that the existing kingdoms, or emirates as they are called, for the most part owed their tottering thrones to a supreme sultan or emir, to whom they paid a certain tribute, and to whom they acknowledged a certain vague allegiance. Just as the kingdoms of India acknowledged the suzerainty of a little more than titular sovereign at Delhi, so the kingdoms of Nigeria acknowledged the supreme chieftainship of a sovereign at Sokoto. The reigning chiefs belonged mostly to the latest dynasty, established by an invasion of about 100 years ago. They were of the semi Arab race of the Foulahs or Fulani, and what the Great Mogul of Delhi was to the India of Clive's day, such was the great Foulah of Sokoto to the Nigeria of four years ago.

The Fulani are a striking people, dark in complexion, from having doubtless intermarried with negro races, but of the distinguished features, small hands and fine, rather aristocratic carriage of the Arabs as we know them on the Mediterranean coast. They are of the Mohammedan religion, and are held by those who know them to be naturally endowed with the characteristics which fit them for rule. Their system, as it exists, has many admirable points. Their theory of justice is good, though their practice is bad; their scheme of taxation is most elaborate, and is carried even into a system of death duties which leaves little for an English Chancellor of the Exchequer to improve. The caravan trade across the desert, which was already old when the Arab historian El Bekri wrote of the country a thousand years ago, and which then supplied the ports of Southern Europe with the leather known to us as Morocco leather, and with many other articles of luxury which English people of that day had not yet learnt to use, continues, and pays its tolls to the Fulani. There is much in their system for those who propose now to rule through them to study. But it is, I believe, generally held that much of what is best in it was already established in the country at the time of the Fulani invasion, and was borrowed by them from the preceding Habe or Haussa dynasty which they overthrew. The history of the country, complicated by a thousand petty wars, is very imperfectly known to Europeans. I do not pretend even to have studied that which is known; but I shall not, I think, be far wrong in saying that, apart from the many differing races of pagans who were aboriginal to the country, the superior foreign races of invaders who have established themselves in it by force of arms may now be divided into the Haussa and the Fulani. The Fulani have come to be the ruling people, but the Haussa, who are also for the most part Mahommedan, form a very important industrial and commercial portion of the population. The cotton cloth of Kano was famous through the world of Africa long before the Fulani had made their appearance as a governing race in history. Iron smelting and smith's work is spoken of in an Arabic MS., not yet properly translated, which carries us back to the mythical ancestry of the founders of Kano. Weaving, dyeing, tanning, brass work, leather work, are among the local industries; and trade in these, as well as in the raw materials with which the country abounds, is largely carried on by the Haussa people.

When, at the beginning of 1900, the authority of the British Government superseded that of the Niger Company upon the river, there were, without taking count of lesser divisions, about sixteen principal States, most of them owing subordination to Sokoto, whom it seemed desirable from the British point of view, to regard as separate provinces, and to bring under separate names within the British system of organisation. I give you the list of their names, though you can hardly be expected to remember them. Beginning at the south there are Illorin, Kabba, Bassa, Borgu, Kontagora, Nupe, Muri, Yola, Nassarawa, Zaria, Bautchi, Bornu, Kano, Katagum, Katsena, Sokoto. Of these, some are further in point of time from the centre of British Government—now established at a place called Zungeru, upon a tributary of the Niger—than Zungeru is from London. Letters posted in London will reach Zungeru in about four weeks, but a dispatch sent by the High Commissioner to a resident in Bornu takes upwards of two months to reach its destination. To send to Sokoto and back is to send a foot-messenger for upwards of 800 miles. Borgu, when my husband first entered the country, boasted—inaccurately, I believe—that no white man had ever come out alive. But that was before the transfer

of the company's territories to the Crown. At the time of the transfer Borgu, which is the western-most province of Nigeria, and borders the French frontier, was securely occupied in British interest by a portion of that native military force of which I have spoken, and which is known as the West African Frontier Force.

The idea of creating this regiment as a part of the Imperial forces was conceived by Mr. Chamberlain, at a time when European frontiers in West Africa were less clearly defined than they are now; and the duty of raising and organising it was entrusted to my husband. In connection with the occupation of Borgu he had curious adventures, and on one occasion put his life absolutely in the hands of Kiama, the King, who had he knew been plotting to kill him only a few days before. The upshot was that the King became his fast friend, and having advised him never again to trust a Borgu man as he had trusted him has shown himself ever since worthy of trust. He stills sends yearly offerings to his "friend," and Borgu gives us no trouble. At the time of transfer Borgu, Illorin, and Kabba were the only three provinces out of the sixteen I have named in which anything that could be called British authority had been established. The others as various in customs, language, population, and territorial conditions as they are widely separated by distance from each other, were all yet to study and to control.

In addition to the Fulani and Haussa races, of whom I have spoken, who profess the Mohammedan religion, and speak either Arabic or Haussa; the country teems with local tribes having each their own habits and their own language. In every province that I have named there is not only one language as in France or Germany or Italy, but perhaps a dozen or more lesser languages peculiar to the district which may more properly be described as patois, but are not comprehensible as from one tribe to the other. The Yoruba, the Nupe, the man from Bornu or Yola understand each other as little as we understand them unless they happen to speak Haussa too, which is to the more educated a universal tongue. Haussa is the language which the English officer learns, but he has to learn many others if he wishes to make himself fully understood by the native peoples, with whom he has to deal. Amongst these people many are pagans. It is not very long since some were cannibals. The pagan tribes are often warlike, intractable, and hardy, inhabiting hill fastnesses and defending themselves from attack by being generally ready to take the offensive. Little is known about them accurately, and the strangest rumours are current with regard to some of them. There is a tribe which is reported to have tails, and there is another which would appear to justify the Greek legend of the Amazons. All their fighting is done by women, and their public offices are also filled by women. I am told, but I do not vouch for the accuracy of any of these statements, that in that tribe the women are physically larger and stronger than the men. In the worst of the pagan regions civilised trade is not at present possible. What is known of them comes I think chiefly from the slave raiding expeditions of the Fulani.

Thus we may roughly divide the population of Nigeria into three parts: There are Fulani, who are the military and ruling class, fast falling into degradation by the vices which are apt to undermine the despotism of uncurbed power but still representing authority as it has existed in the eyes of three or four generations. There are the Haussas, once themselves the ruling race and now representing the industry, the agriculture, and the commerce of the country. And below these there are the tribes too numerous to catalogue who make up a people of great antiquity, but, so far as we have been able to learn, of an always restricted conception of civilisation. These tribes vary very much among themselves, and the higher types of the Northern States would legitimately protest against a classification which should seem to lower them to the level of the cannibal pagans of the Southern Coast. In Borgu the people claim that they have never been conquered by the Fulani, and they have traditions of a religion which would appear to be Christian.

But through the variety which I have endeavoured to indicate there was at the time of the transfer one custom which was the same in every province, one blight which fell on all prosperity. From end to end of the Protectorate it was the habit of the strong to raid the weak for slaves. It is a habit which has endured for centuries. Until the application of modern science railways, steamers, &c., made it possible for civilised administration to penetrate to the interior of continents, there was no opportunity for modern sentiment on this subject to make itself felt. And we have to remember that our own sentiment on this subject is of comparatively recent growth. Leo Africanus, writing about 1526, tells how when he travelled by way of the desert into

the territory which we now call Nigeria, he and the company of merchants he was with were obliged to wait for nearly a year in Bornu, while the king, who was at first otherwise occupied, carried out his annual raid for slaves with which to pay for some horses they had bought, yet there was so much gold in the country that Leo Africanus described the household utensils of the king as being made all of pure gold. Just about that same time, Cortez was sending home natives from Mexico to be sold in Spain as slaves; and, later than that, Sir Francis Drake sailed on his first voyage with Sir John Hawkins, on what can only be described as a slave-raiding expedition to the West Coast of Africa, the proceeds of which were sold at a great profit to the Spaniards in the West Indies. In Nigeria, at the time of the transfer, the principal currency of the Protectorate was in slaves. Large sums were reckoned, not in pounds, but in slaves. Public tribute was paid in slaves. All labour was practically slave labour. The old annual system of raiding was maintained, and every year vast armies took the field for the purpose of raiding the villages and towns of those not strong enough to defend themselves. The pagans were, of course, the proper prey of the Fulani slave raiders, but as they became exhausted by the hideous desolation—for man may be destroyed just as game can be destroyed by indiscriminate hunting—or learned as some of the hardier and more warlike among them learned how to defend themselves from the raiders, the slave-raiding armies turned themselves towards their own outlying rural populations. It became a case of a nation devouring itself, and in the later years of this destructive system the country was being absolutely depopulated. Where Barth describes in 1854 a population of some fifty millions, there are probably not more to-day than ten or twelve millions. Yet so wedded are the Fulani rulers to a system which is, after all, the only one they have known as a means of procuring wealth, that when on the assumption of power by the British Government the Emir of Kontagora was remonstrated with, and asked to give pledges of abstaining from slave-raiding for the future, his reply was, "Can you stop a cat from mousing?" "When I die I shall be found with a slave in my mouth."

It is no matter for surprise that the lower types of the inhabitants of Nigeria should be found on the further outskirts of the country to the south and east for the centre of wealth and power and civilisation, the centre also of slave-raiding was in the north-west. Sokoto, Kano, and Katsena represented respectively the heads of political power, of commercial power, and of learning. Sokoto was the residence of the Sultan. Kano was the great market of North Africa—a market which was in existence at the time that our own Tower of London was building. Katsena was at one time the university town and centre of Haussa learning. In these towns something approaching to architecture is to be found. Round about them there are great roads enclosed between hedges. Wide spreading fields carry crops of corn and cotton and tobacco. Crowds clad in the Moorish fashion of turbans and flowing robes daily throng the thoroughfares. Their soldiers still come out to fight caparisoned in chain armour. Camels, truly named for centres such as these the ships of the desert, carry merchandise from this fertile country across the Sahara sand to the Mediterranean coast. Here in these far inland States, remote from touch with European civilisation, is all the light and leading of the country. Bornu, lying east of these and cradling Lake Chad, has a history and traditions of its own even more ancient than those of Kano, but Bornu has long been desolate, its glory sacrificed to the vices of its rulers, and while Sokoto retained the political and religious headship, Kano was and is by common consent regarded as the most important of the Haussa States.

The problem then that lay before the Government, which it was my husband's duty to initiate, was how to bring these sixteen kingdoms and their scarcely known petty dependencies into some ordered form of civilised administration. With an administrative staff scarcely numbering a score of men, there could be no question, even had it been on grounds of equity or policy desirable, of establishing an entirely European form of government, and administering the whole country by Europeans. As many thousands as he had tens at his command would have been necessary. Nor was such a proceeding at any time contemplated. India again furnished a parallel, and the system which it was determined to adopt was practically the Indian system of ruling through native princes. by the intermediary of a British Resident, who, with a small staff of white men, is established at the head-quarters of each Emir, and who acts as the guardian of the treaty rights conceded in each case by the Emir.

It would be impossible for me in the time which is at our disposal to-day to relate to you the circumstances by means of which in less than four years every province in the Protectorate has been brought within this scheme. The process has of course necessitated many military expeditions. The little army of the West African Frontier Force has borne its gallant part in winning this country not only for the Empire but for civilisation. And these expeditions have not meant only fighting even in their actual conduct. They have served to obtain knowledge of the country and the people which owing to the awful disorder and desolation to which we succeeded were fast dying back into primitive barbarity. I cannot dwell on the horrors which took place before our rule, but you can imagine for yourselves what it must have been in a country where not only every defenceless person but every defenceless village was liable to be marked out as the prey of marauding slave-hunters. And the populations which were so raided are naturally for the most part peaceable, lovers of agriculture and of the humbler kinds of domestic industry.

What seemed imperative if order was to be established was to give protection to these the natural inhabitants of the soil. To this end it was essential to stop slave-raiding. And here at its very source, in the centre of the Dark Continent itself, England may proudly boast that under her flag slave raiding has come to an end. About this time last year the West African Frontier Force conducted a successful campaign through Kano, Katsena, and Sokoto, with the result that those provinces accepted the suzerainty of Great Britain on the same terms on which it had already been accepted by every other province of the Protectorate. Amongst those terms the cessation of slave-raiding stands first.

But I have already said that slaves constitute the most important source of wealth of the rulers, to whom tribute in slaves has hitherto been paid. It is, therefore, essential if the rulers are to remain satisfied under the new conditions of their rule, to substitute some other form of wealth. This is one of the difficult problems of administration with which it is hoped to deal successfully. In the province of Illorin, where we have been longest in occupation, it has been proved that in the increased prosperity which peace has brought, the regularity with which the Emir's tribute in money has been paid, has more than compensated him for the gains which he made under the old system. He professes himself to be entirely satisfied. It is not yet certain that this will apply in the provinces of Kano and Sokoto; but it is certain that no method of enrichment for a ruler can be more disastrous than that which spreads ruin through his country, and it can, therefore, be only a question of finding the right way to give him a portion of the wealth produced instead of the whole of the wealth producers of the country. If the country is richer, as it presumably will be, there should be no impossibility about finding a means to give him as much as he has had, and still to leave something plus their liberty for his subjects.

Domestic slavery is a question apart from, though not unconnected with, slave raiding. The two questions have to be treated separately. The one involves a change in the whole intimate social system of the home; the other is a question of the maintenance of public order. There is a very great difference between the civilisation of a country in which the institution of domestic slavery is accepted, and that of a country in which the laying waste of vast areas and the enslavement by force of defenceless populations is permitted. In Nigeria it is judged that the time has not yet come for dealing directly with the question of domestic slaves.

We may say, therefore, that in the British administration of Nigeria the first step has been achieved. The people have been restored to the soil. It is a great step, one which has only been achieved by ceaseless labour, and the loyal co-operation of all parts of the civil and military staff. It is comparatively easy to sit at home and think, "Oh, well I suppose it got done somehow." One must have been there and watched them at work in order to realise what toil, what pluck, what initiative, what sturdy endurance it has needed to bring the first shaping of the enterprise to the successful issue it has reached. We know not, of course, at what moment we may hear of coalition of the dissatisfied against us, of revolt, of partial check. These things occur in the history of all countries. They will doubtless occur sooner or later in the history of Nigeria. But in the meantime that has been done which it was intended to do. A vast country has been brought under one flag. It has been organised for administration on an English basis of justice and clemency.

In every province as it was brought within our systems of administration, a British Resident has been placed at the head-quarters of the reigning Emir, and a British Court of Justice has been

established. A doctor, and, in some cases, a small military detachment have been left to support the political staff. The Resident and his assistants are instructed to acquire information on all native questions and subjects of general interest, especially including the topography and economic products of the areas committed to their charge. In each province there is, therefore, now a nucleus of white influence, which can scarcely fail to work for the general enlightenment and development of the country.

The curse of slave-raiding, which was killing the land by depriving it of all the natural industry of its inhabitants, has been removed. In doing this force has been frankly used where it was necessary, either to maintain respect for treaty obligations contracted with us or in opposition to other force with which we were threatened, but that force has always been exercised within the strictest limits of discipline. That it has never been abused may, I think, be inferred, from the conditions which, after many campaigns that must have spread the reputation of the army through the Protectorate, were found to prevail during the recent expedition on the road to Kano and Sokoto. The towns passed by the British on the way, instead of closing their gates or removing all valuables to the bush, remained quietly open, and the inhabitants brought ample supplies which were duly paid for as though no war was being waged. Traders continued to use the road, and even women, meeting the troops, did not turn out of their path. No outrage, no arbitrary conduct of any kind was permitted. Within three days of the occupation of Kano, the market was in full swing, as in time of peace. The description given in the official report of the perfect confidence that prevailed, reminds me of a description of our very first attempt at tropical colonization by the landing of the British in Guiana, under Sir Walter Raleigh, in 1595. "The natives came," Sir Walter Raleigh says, "to wonder at our nation, and to bring us down victual, which they did, in great plenty." They also talked of geography and history, and many things that made him marvel, to find men of that gravity and judgment, that had no help of learning. He took care that they should be well treated, and, on a subsequent occasion, they, as at Kano, brought ample food and drink which Raleigh insisted "should be paid for as though no war were being waged." "The English chief," his historian says, "was stern in his requirement from outset to return of the long journey, that all such scenes should resemble an Englis[h] market. Everything was paid for. This stri[ct] justice, the as strict protection of the nati[ve] women, not from outrage merely, but fro[m] the slightest discourtesy, together with th[e] general countenance that was shown to ther[m] completed in the minds of the Indians th[e] contrast between the English and others [of] whom they had had experience, dwelt in the[ir] memories, and was handed down by traditio[n] to their descendants."

It is a tradition of which we may be prou[d] and it is pleasing to think that it is th[e] inheritance of the latest from the earliest [of] the tropical enterprises of Great Britain.

But to put a stop to slave-raiding, t[o] establish on the sixteen thrones of th[e] Protectorate, sixteen Emirs who shall bin[d] themselves to govern in accordance wit[h] enlightened conceptions of justice and merc[y] is far from being all that is required i[n] Nigeria. These are but the first steps b[y] means of which we, as it were, reclaim [a] waste from history for cultivation. When w[e] have given protection to the soil and order t[o] the government, we naturally hope that som[e] material advantage shall result.

We have here a wonderfully fertile an[d] well-watered country, rich, too, in minera[l] indications. In its more southern limits, an[d] especially in the river valleys, it suffers fro[m] the curse common to all low-lying tropica[l] countries, of an enervating climate, which, i[n] the case of the white man, predisposes hi[m] to malarial fever, and too sorrowfully swell[s] our death roll. The hearts of all Nigerian[s] are sad just now for tbe loss of Captain Abadie[,] dear to all who knew him, and one of the fore[-] most of the little band of pioneers of whom I have spoken. But, as the country stretche[s] inward and upward from the coast, it rises t[o] fine and healthy plateaux, across which th[e] dry air of the Sahara blows with invigoratin[g] force. Zaria and Bautshi, which occup[y] the centre of the Protectorate, have a[n] elevation of from about 2,000 to 3,00[0] feet above which mountain peaks attain t[o] much higher ranges. The country which lie[s] between them and the northern limit of th[e] Protectorate has been reckoned for centurie[s] amongst the productive centres of the world[.] Bornu, ravaged now and desolated by lon[g] courses of uncurbed tyranny, was once so ric[h] that it was the marvel of travellers who visite[d] it. The cities of Negroland were the mart[s] of Northern Africa. Gold was plentiful in thei[r] country. I have already told you how th[e]

ıltans of Bornu were served in utensils of ıre gold. The same custom prevailed in elle, where, in the 14th century, the lower indows of the Sultan's palace were framed in ɔld plate, while the upper windows were framed silver plate. Their leather exported through e port of Morocco, and, taking its name from at accident, has long been famous. Their ɔtton cloth grown and woven by the peasantry Kano and other districts, was carried to uropean markets by Arabs, something like ooo years ago. The country once so rich has en thrown into decay by the ceaseless raiding its most valuable product—man, and the con- quent withdrawal from the land of the industry, ssential to its development. But there is no ason now why industry should not return its natural channels.

The people of Nigeria have two traditions hich are extremely valuable from the point of ew of the restoration of the country to pros- rity. They have the tradition of agriculture d the tradition of commerce. It has been uching in some parts of the Protectorate in hich the natives have been assured of ımunity from hostile attack to see how adily they have flung themselves upon the il to cultivate it, and throughout the country, pecially in the northern Haussa States, there e widespread signs of the natural instincts the people as an agricultural race. Among e most valuable of their crops is cotton, of hich they were cultivators already while we ere hardly yet an English people. They so cultivate rice, corn, indigo, tobacco, ions, ground-nuts, and show a readiness bring these commodities with the produce their forests to market. The numerous and spectable body of the people who belong to e Haussa race are born traders. They have en traders for all time. They are to be und in every province of the Protectorate, d during the travelling season the entire rotectorate is traversed in such portions of it are peaceable enough to render possible the ıssage of the roads by a network of trading ıravans. Since the occupation of the country the British a record has been kept on the incipal caravan routes of the caravans which ıss and of the goods they carry, and from ese statistics a most interesting picture can ın be constructed of the variety and detail of cal trade. Even in the most distant parts Yola caravans from Kano may be noted inging leather work and native needle- ɔrk and native paper, while the wilder cal produce of ivory, rubber, gums, and elephants' tails may be counted in the caravans of the return journey. But the principal volume of caravan trade is with Illorin. Throughout the dry season of the year there is a constant procession of caravans carrying chiefly potash and leather to the coast. The return load of these caravans, is, of course, European goods, which are at present carried chiefly on men's heads the whole way to Kano.

This caravan trade, such as it exists, has been perpetually interrupted by states of war between one native potentate and another, and even when not interrupted, is hindered and molested by the insecure state of the roads. Caravans have been obliged to travel armed and ready to defend themselves.

Now that the whole Protectorate is included within the effective area of British administration, it is hoped that we may secure such peace from border to border, as may enable every road to remain permanently open, and to be travelled without fear. Already bodies of caravan leaders have come to offer their thanks to the British Government, stating that one man can now travel alone on roads upon which—before the British era—only strong armed caravans could venture to pass. We hope to do more than this, we hope to improve the roads and the means of transport, thus to facilitate movements from one part of the Protectorate to another, and so to stimulate the national impulse to trade, that its channels may widen into important streams that shall nourish the country and contribute usefully to the commerce of the world.

This is no unsubstantial dream. The trade of Kano, which has been hitherto done with the Mediterranean coast by means of camel transport across the desert, is so important that, though we have no statistics of its volume, it has formed the theme of every historian, Arabic or European, who has dealt with the condition of the country. In the market of Kano the trade is said to be sufficient to occupy some 200,000 persons. Among the conditions accepted by the Emir whom we placed last year upon the throne of Kano is one that he will keep his roads open to our trade. Now if—as we hope may, before long, be done—a light railway is carried from the navigable Niger to the gates of Kano, and British traders make good the opportunity thus offered, it does not seem too sanguine to suppose that a considerable part, at least, o that produce which has freighted the caravan trade of the north, shall find its way by readier

and cheaper means to the markets of Great Britain.

But there is another and far more important element of potential trade with Nigeria. The shortage of cotton from which Lancashire is now suffering has become a matter of very serious national concern. The words put into His Majesty's mouth on the occasion of the opening of Parliament, indicate the grave attention which the matter is receiving from Ministers. Lord Rosebery, speaking not long ago on a subject which shall be tabooed this afternoon, gave an indication of the view likely to be taken by the Opposition. Enumerating various practical ways of contributing to the welfare of the Empire, he said: "You might cultivate cotton-growing within your Empire. If you could develop the yield of cotton within your Empire you would have done more good in a short time than would be effected by all the political pilgrimages of which we are a witness at this moment." It would seem, therefore, that both political parties are agreed as to the importance of developing the culture of cotton within our own dominions.

In Nigeria, spreading widely over the healthy part of it, there is a district of about 27,oco square miles in extent, where the population cultivate cotton in broken patches, where this cultivation has been a traditional industry for as long as man can remember, and where, with peace assured to them, the population ask for nothing better than to increase the industry indefinitely. They are willing, even eager, too, to grow better kinds of cotton. There seems no reason why, in these districts, white men should not before long go out to settle, and, like the tea-planters of India, create a great industry which should, within the Empire, produce the greater part of the raw material required to feed our cotton manufactures.

It is a relatively minor detail that, if the volume of Nigerian production should rapidly increase under an administrative system of which the principal object has been to restore labour to the land, and to secure the labourer in the possession of what he earns, some other means will be required of conveying the increased produce to European markets than the primitive system of human carriage. That goods should be carried on men's heads is the most expensive, the most cumbersome, and in every way most unsatisfactory method of transport that can be devised. A man's load is 70 lbs. A ton of cotton requires 32 men to carry it. Say it has to come a fortnight's walk to the river, say that a plantation is sending down five tons. Thus 5 by 32 or 160 men must spend a month going and coming. During all that time they must be paid and fed, and their labour is removed from the land on which it might be profitably employed. On a railway the same five tons would be expeditiously and cheaply conveyed, and no labourer need leave the fields. The system of carrier transport is amongst the causes which contribute to the impoverishment of all native States in which it is practised. There are yearly in Nigeria hundreds of thousands of persons doing nothing but walking about the Protectorate performing the part of beasts of burden. To liberate this labour for the land would not be the least part of the service to be rendered to the country by light railways.

I had intended, when I began to write this paper, to speak chiefly of the lighter side of Nigerian life, the side of which alone I had myself any experience. But I have found myself irresistibly drawn to the more serious side, and I trust you will forgive me if in speaking to you of a subject which is naturally so near to my own heart as the successful development of our tropical dependencies, I have had confidence that the solid interest of the questions involved would plead its own cause with you.

DISCUSSION.

The CHAIRMAN was sure the audience would wish him, on their behalf, to thank Lady Lugard for the most interesting and admirable paper she had read. He had had the pleasure of listening to a very similar paper given by Sir Frederick Lugard before the Royal Geographical Society. But Lady Lugard, though she had given them a certain amount of information which they had heard from Sir Frederick Lugard, had added to the fascinating story of the history of Nigeria a light and delightful touch which he thought alone could come from ladies in describing any matter of interest. One of the first remarks which fell from Lady Lugard which struck him as being absolutely true, was the fact that it appeared at the present that England had centred its ideas and thoughts more on South Africa than on the West African colonies and dependencies. He quite agreed with Lady Lugard that the possibilities of further developing the trading resources between the West African colonies and Great Britain were very great indeed. For instance, ten years ago English trade with the Gold Coast only amounted to £1,000,000 a year, while to-day it had increased to something like two millions a year. He thought they

ould. therefore, thoroughly appreciate what Lady Lugard said, as to the importance of remembering the trading possibilities that existed in those arts of the country over which England exercised a rotectorate. Much had been done of late to discover hat fell tropical disease from which everybody uffered so much on the West Coast. Investigations ad been made in that direction, and it was elieved that the sources of the malaria which revailed there had been discovered. Having ound the sources of the trouble, it was hoped hat methods might be taken in years to come o entirely, or partly, eliminate that terrible enemy gainst the continuous existence of the white man n the West Coast of Africa. Nigeria was by far he biggest, and perhaps the most interesting, of ur West African possessions. Lady Lugard had reminded the meeting that it was a third the size of ndia, and he thought she also said there were ten or welve million natives residing in the territory. He ancied there were a considerably greater number; ut owing to the fact that they killed each other their umber had been very much reduced. But what mazed him most of all was that that enormous terriory was managed, administered, ruled, and kept in rder by a mere handful of British officials and oldiers under the control of Sir Frederick Lugard. He thought he was right in saying that there were not more than two hundred white men in the whole of Nigeria; and when one considered that fact, it was marvellous to think of the work that Sir Frederick nd those under him had been able to accomplish in he six years he had been there, not only in fighting the Fulani, and bringing them under his rule and authority, but in being able to conciliate them and make hem recognise the justice and advantages of British ule, so that to-day it might be said that comparaive, if not absolute, tranquillity was reigning throughut the whole of Nigeria. Of course, Sir Frederick had still many more anxious years before im in Nigeria. His efforts at the present time vere directed towards making the inhabitants of Nigeria still more tranquil and hard-working, towards bolishing completely that horrible system of slavery, which had been such a curse to the country; and, lthough trying to preserve existing customs and institutions, towards endeavouring to weld and dovetail them in with British ideas, customs, and institutions. That was the great work which was before Sir Frederick, and one in which he was sure all those resent wished him every possible success. Lady Lugard also referred to another very important matter, namely, the possibilities of growing cotton in Nigeria, and also to the extension of railway communications. He thoroughly agreed with her that both hose matters were of vital importance. She had reminded them that to-day the people of Lancashire vere in a condition of considerable distress owing to he fact that a sufficient supply of cotton could not be btained from America, and that a distinguished tatesman had said that it was the duty of England to do all in its power to grow cotton within the British dominions. He quite agreed with the views of that statesman, and that the subject of developing the sources of the raw material of cotton in British possessions was one which was outside party politics; it was a national one, and they all ought to cooperate, and do their best to see that the suggestion made by Lord Rosebery was carried out in the years to come. But, of course, there were a great many difficulties in the way. In the first place, there were no railways in Nigeria, and when those railways were likely to be built, it would be very improper for him, occupying the subordinate position he did at the Colonial Office, to in any way try to indicate. But he thought it would be some time. The distances were very great, and the question of finance was one that always exercised their minds. There was a surveying party who were trying to discover the best routes for the railways, and when they had made their report it would then be for the statesmen who controlled the destinies of this country to decide whether they were prepared to sink a considerable amount of capital in developing the resources of Northern Nigeria, so that the distant places in Nigeria might be brought into closer touch and communication one with the other. Efforts were already being made to grow cotton in Southern Nigeria; and in a spot known by the name of the Sobo Plains, the British Cotton-Growing Association had acquired, or was going to acquire, a territory where they hoped to make a pioneer movement to show that it was possible to cultivate cotton advantageously, both to the cotton grower and also to Lancashire. Lady Lugard pointed out the close resemblance of the administration of India a hundred years ago with the present administration of Nigeria. They all remembered the difficulty that Warren Hastings had to contend with in India, and they could not but be struck with the fact that those which Sir Frederick had to contend with were of a similar character. Like Warren Hastings, Sir Frederick Lugard was a pro-Consul and a pioneer in developing territories over which England had acquired a right; but although they remembered the name of the former with considerable pride and admiration, he differed from Sir Frederick Lugard in one respect, whereas Warren Hastings, at the end of his career, lost the confidence of his countrymen at home, Sir Frederick Lugard's administration in Nigeria had in the past, and he felt sure would in the future, not only always commended itself to the goodwill and admiration of the Colonial Office, but equally to everyone present, and all British men and women, as being a sound, a careful, a prudent, and, above all, a humane administration.

The Earl of SCARBROUGH said he was glad to have the opportunity of thanking Lady Lugard for her most interesting paper. Attractive as he knew it must have been even to those present who had only a superficial and outside interest in Nigeria, they could understand how exceptionally interesting

it was to those who had, in one way or another, been more or less identified with its early development. All present recognised that Lady Lugard had special knowledge of her subject. She had not only the advantage of having a husband who was a High Commissioner, and of having visited the territories herself, but she had, to his certain knowledge, for a number of years interested herself in, and materially helped on, the early stages of the growth of Nigeria. He had always attributed to her, rightly or wrongly, the origin of the pleasant-sounding name of Nigeria, which took the place of the very cumbrous titles of the Territories of the Royal Niger Company, and the Niger Coast Protectorate, by which the river and its delta were known in the days of the Charter. He was glad, too, that Lady Lugard had seen fit to draw attention to the more serious side of her subject, because the general public had few enough opportunities of getting to know how work was done in the outlying estates of the Empire. They were dimly aware that a vast territory had been, so to speak, harnessed for their use, and that it was supposed to have great commercial potentialities, but they had no idea of the process, the "spade work" that had been in operation. That process had been going on for a quarter of a century, and it was to the last four years of that period that Lady Lugard had more directly called attention in her paper. In regard to the major portion of those twenty-five years, he trusted that some day the founder of Nigeria, to whom reference had been made that evening, might be induced to fill in the picture, and to describe the birth and growth of a great idea, solely and entirely his own, which culminated in the year 1900 in the handing over to the Crown of a territory which had already been referred to as equal in size to one third of India, and also a great waterway on which it was as safe to travel as the River Thames. Certainly it was given to a few men, as it had been given to Sir George Goldie, to witness his life work developing with the remarkable rapidity that Nigeria had done. Nigeria had been fortunate in the High Commissioners who had taken his place. Lady Lugard had graphically, but too briefly, described what her husband had done during the last four years. She might well be proud of his accomplishments. What Sir Frederick had done had been due, to his (the Earl of Scarbrough's) mind—and he knew him well—to his extraordinary ability for organisation, and his unlimited capacity for work. He was quite sure that Mr. Wallace (whom he was glad to see present), Sir Frederick's able deputy, and, if he might say so, his right-hand man in all his operations, would bear him out in that remark. He would like to refer in a few words to what Lady Lugard called the material advantages, which it was hoped would be derived from the acquisition of Nigeria. He was perfectly well aware of that, for imperial reasons, it had been necessary to act promptly in efficiently occupying the whole of that huge territory; but he thought Lady Lugard would agree with him that from the commercial point of view, the pace had been rather too hot. Trade and commerce in Nigeria would not advance by leaps and bounds; it would only be a slow and steady progress. Apart from mineral developments, he could not help feeling that it would be some years before the revenue of Nigeria overtook its expenditure. Lady Lugard had clearly pointed out the reasons for that. During the Foulah rule the country was devastated by slave raiders. No life or property was safe for the mass of the people, and consequently there was no inducement to grow rich and no incentive to labour. Now the British had gone in as conquerors the country required time to realise that, under our rule, the previous state of affairs had changed. He submitted that the first duty of the Government was to give the natives confidence, and to help them once more to revive their natural instincts for agriculture and commerce. The next difficulty was the question of labour. There had been no inducement hitherto for the natives to labour beyond their actual requirements. That was another difficulty that would take time, and which would have to be faced, both in regard to the collection of natural products, and in regard to possible cotton cultivation in that country. He wished to say that he heartily sympathised with the objects of the Cotton Growing Association. He believed that when the labour difficulty was overcome Northern Nigeria would very materially help the Association to realise its object, but he urged the administration, in the first instance, to confine their encouragement of the cultivation of cotton to the districts close to the river, for instance in Nupe, where the difficulties and cost of transport would be minimised. In conclusion, he wished to assure Lady Lugard, and, through her, the High Commissioner that the Niger Company intended, to the best of their power, to further his efforts in the direction of developing the interests of the country. Their goal was the same, and if they did not travel along the road quite so fast as Sir Frederick did, he hoped he would not think that the company was a drag on the wheel. In regard to not only West Africa, but all the British tropical possessions in Africa, he had long felt that they had suffered from what he might call hot and cold fits of Government. There were constant changes at home; there were necessarily constant changes in the responsible officials on the coast, which meant a want of continuity of policy and purpose which was a very great hindrance to real progress. He ventured to submit that the true remedy for that state of things was that an African council should be established at home, more or less on similar lines to the Council of the Secretary of State for India, for the purpose of dealing with all questions affecting our tropical African possessions; and he sincerely hoped that a step in that direction might before long be taken.

Sir John Kirk, G.C.M.G., K.C.B., said that, looking at the paper from the point of view of an

administrator, he quite sympathised with all that had been said. He was able to bear testimony to the work done by Sir Frederick Lugard, not only on the West coast, but on the East coast of Africa, with which he was much more familiar. The problem on the West coast was much more simple than on the East. There was an industrious population, a river which was more or less navigable, and a race that could be developed into a governing class, a state of things which did not exist on the East coast. He thoroughly endorsed all that the Earl of Scarbrough had said in regard to the necessity of moving slowly at first into the more remote parts, and that the country nearer to the river should be first developed, where it could be served by tramways or light railways. Until that was done, cotton industry could not develop and compete with places nearer the coast. The Government must develop the means of transport first; the people were there, the country was suitable, and everything was ready, only it must take a certain amount of time. He thought it would, undoubtedly, be a great advantage if people, with a wide experience of Africa, like Sir Frederick Lugard, could be utilised at home to give advice on the undertakings which could be most profitably and easily carried on in our tropical possessions.

Mr. ALFRED EMMOTT, M.P., after expressing his cordial thanks to Lady Lugard for the most interesting account she had given of Northern Nigeria, said that he thought England had in Sir Frederick Lugard one of the highest types of British administrators that the country had ever produced. He had shown himself able, energetic, and successful in war, and a great administrator in times of peace; and he thought he might say, on behalf of all present, that there was not much to fear for the old country so long as she could produce men like Sir Frederick Lugard. He could say that all the more cordially because he happened to be one of those who feared very much the expedition which ended in the fall of Kano, who feared the risks run and the danger that the trade, for which Kano was the great emporium, might be driven over the border into French territory, and find its home in Zinder. He wished to say a word on the question of cotton as it affected Northern Nigeria. He was a little troubled by what His Grace had said. He thought it was a matter of the utmost importance that if anything was to be done in the way of growing cotton in Northern Nigeria that a light railway should be built quickly and at once. He knew it would cost money, but at the present time England was giving £400,000 a year as a subvention to the country. A light railway could be built from a suitable point on the Niger, through Zaria to Kano, at a cost of, he believed, between half-a-million and a million. It would take some years to build a heavy railway, and many millions to construct it. In the meantime a light railway would show what could be done in the way of exporting cotton and importing goods in return. He did not think the industry could wait for a heavy railway. He would not further discuss the question, but merely say that he was a little disappointed at what His Grace had said, because those who were interested in the question of growing cotton were most earnestly anxious that a light railway should be built without delay, and that the matter should not be postponed until a heavy railway could be built.

Mr. SYDNEY BUXTON, M.P., thought that the question of the supply of raw cotton was altogether outside and above party politics. As far as he knew the feeling of those with whom he worked was that encouragement should be given to the colonies to grow raw cotton. It was a matter of such vital importance to the greatest industry of the country that he did not think there would be any difference of opinion on either side of the House or in the country if this Government, or some succeeding Government, took energetic means to encourage the growing of cotton in the different colonies. Cotton had already been grown in Nigeria, and it was, therefore, a very good country to make experiments in. He agreed, however, perhaps more with the Chairman than with Mr. Emmott in regard to the question of railways, and thought that in such matters experiments should be made first before a light or heavy railway was constructed; but if the experiments, which he understood was being made at the present time, were successful, he felt sure that the country and the House of Commons would not begrudge as much money as was necessary to make a light railway for the purpose of developing such an industry. He thought they would do so for the very good reason that if the experiment was successful it would certainly pay the country in the long run, and instead of having to increase the subvention to Nigeria, probably in the end it would be able largely to reduce it. It was a question of real practical importance at the present time, and one to which he was very glad that public attention had been called at the meeting. Everyone present had listened with the greatest possible interest to the paper, and felt that in Sir Frederick Lugard they had a great public servant; but much as they appreciated Sir Frederick's invaluable services in Nigeria, and much as they desired that he should not give up his service there, he for one hoped it might not be long before he was called to a higher place and higher service in the country for which he had done already such admirable work.

On the motion of the CHAIRMAN, a hearty vote of thanks was accorded to Lady Lugard for her valuable paper.

Lady LUGARD, in reply, thanked the audience very heartily for their kind expression of approval, and still more wished to acknowledge her gratitude for the expressions of appreciation of her husband's work that had fallen from the various speakers, and which

had been so cordially endorsed by those present. She was sure everyone present would join with her in thanking His Grace the Duke of Marlborough for his kindness in taking the chair.

Professor WYNDHAM DUNSTAN, F.R.S. (Director of the Imperial Institute), who was obliged to leave during the discussion, writes:—Lady Lugard has drawn a most attractive picture of the future of Northern Nigeria, but certainly has not exaggerated its possibilities. She has, indeed, not referred to its mineral deposits, which may turn out, on examination, to be of considerable value, although commercial development will have to wait in this, as in other matters, for the provision of transport. This, however, is not a reason for delaying to ascertain what the resources of the country are, and Sir F. Lugard has already taken steps in this direction, in which I was glad to have been able to render some assistance. Preliminary specimens of mineral and vegetable products collected in various districts of the Protectorate were sent by Sir F. Lugard to the Imperial Institute for examination, and a report on their nature and value has now been issued by the Colonial Office (No. 26, 1904). Of the minerals, the most important specimen is of tin-ore from the Bautshi Province. This proved to be rich in tin (63 per cent.), and could be easily worked for the metal. If, as is alleged, ore of this quality is abundant, Northern Nigeria may eventually become one of the great tin-producing areas of the world. Among the vegetable products deserving attention are gums, and oil seeds of commercial value. Rubber plants occur, and could, no doubt, be cultivated in many districts, whilst cotton growing has long been a native industry, and as Lady Lugard has said, this is a subject of the first importance, not only to Nigeria, but to this country. Its consideration should not be delayed because means of transport are not at present available. Cotton cannot be successfully grown on a large scale except after numerous experimental trials to ascertain the varieties best adapted for planting and the districts which are most suitable for its cultivation. There is no reason why this pioneer work should not be proceeded with at once. The results obtained will, no doubt, expedite the provision, by Government, or by private enterprise, of the facilities for transport which are necessary for the commercial development of the subject.

FOURTEENTH ORDINARY MEETING.

Wednesday, March 16, 1904; PROFESSOR J. M. THOMSON, LL.D., F.R.S., in the chair.

The following candidates were proposed for election as members of the Society:—

Brett, Jasper, Sir Jamsetjee Jeejeebhoy School of Art, Hornby-road, Bombay, India.

Chapman, A. H., Kurow, Oamaru, New Zealand.

Finlay, James Fairbairn, C.S.I., India Office, S.W.

Fitz-William, C. B. Raoul, 29, Henry-street, Po[r]t of Spain, Trinidad, British West Indies.

Hambling, William George A., Forest-house, Queen's-road, Reading, Berks.

Hocart, James Hamilton, 28, High-street, Lambeth, S.E.

Jooste, William J., Rand Club, Johannesburg, Transvaal, South Africa.

Jopling-Rowe, Mrs. Louise, 7, Pembroke-garden[s], Kensington, W.

Taylor, Herbert, Boston-house, Kingston-crescent, Portsmouth.

Windschuegl, Charles H., Leadenhall-buildings, 1, Leadenhall-street, E.C.

The following candidates were balloted fo[r] and duly elected members of the Society:—

Barretto, Frederico Demée, Vice-Consul for Mexico, Hong Kong, China.

Bundy, Frederick E., Castries, St. Lucia, Wes[t] Indies.

Butler, James William, Blyth House, Humber-road, Blackheath, S.E.

Smith, Edward Turner, A.M.I.Mech.E., Lago[s] Government Railway, Lagos, West Africa.

Webb, George Arthur, A.I.E.E., P.O. Box 69, Durban, Natal, South Africa.

The paper read was—

BUILDING STONES, NATURAL AN[D] ARTIFICIAL.

By L. P. FORD.

I.—INTRODUCTION.

I approach this subject, not as a scientific but as a business, man who has, by special circumstances been compelled to study the subject from the purely practical point of view. Naturally, even from that side of the subject, one is driven to consider some of the scientific phases of it; and, in the discussion which may follow the reading of this paper, i[f] any chemical or other question arises which I cannot satisfactorily answer, I have asked some scientific friends to be present who wil[l] be able to do so.

II.—HEADS OF ENQUIRY.

When I found myself, so to say, "landed" in the endeavour to imitate as near as possible the conditions found in nature in the formation of stone, the following questions naturally presented themselves to me, namely, the origin of the principal rocks; their distribution and their qualities for building purposes. Then, of course, the known departure

n a state of nature and the creation of present artificial surroundings, necessitated going still further and finding out, *inter a*—

Vhat our modern atmospheres consist of.

'he efforts that have been made to counter- or prevent the deleterious effect of such ıospheres.

\lso, for the same reason and purpose, the :mpts which have been made to produce an ificial substitute for natural stone.

'his again led to an examination of con- tes, and the difference between them and a : artificial stone.

now proceed to take up these points : by one.

III.—The Origin of Rocks.

\s it would be absurd to attempt to describe a short paper, the supposed origin of all nes, I shall touch only on that of the most nmonly known, namely granites, marbles, estones, and sandstones.

ìranites, according to the geologist tton's actual observation, have resulted n a state of igneous fusion of from 55 to 80 cent. of silica with felspar and mica, in presence of vapour of water, and under a h degree of pressure. Mr. Sorby, and re recently Dr. Firkal, found, on micro- pic examination, that the quartz contains ıute cells partially filled with water, which arly infers the presence of steam under great ssure, and this pressure Mr. Sorby calcu- :s, from the extent to which the cavities are v filled with fluid, to have been caused, in the e of the granites on the Scotch Highlands, ooo feet of superincumbent rocks more than se of Cornwall. Limestones are, for the st part, rocks formed, in deep waters, by rine animals, which have assimilated the careous matter dissolved in the waters of ocean by the aid of the carbonic acid, ɔ found therein, and converted the former ɔ bones and habitations in the form of shells. ese organic deposits have, in some cases, :n afterwards covered up by several other ɔosits, such as clay, sand, and gravel.

\mongst the limestones, there are two ich should be specially mentioned, namely, tland and magnesian limestone, or dolo- :e. The former has a preponderating ount of carbonate of lime, and the dolomite ıost equal proportions of carbonate of e and carbonate of magnesia.

ſarbles are fine crystalline limestones ɔable of receiving a polish.

Sandstones are composed chiefly of silica grains of variable size, bound together by some cementing material, such as carbonate of lime or oxide of iron, or by great pressure in the presence of high terrestial temperature. Sometimes either mica or carbonate of lime in quantity, or felspar, is found added, and gives us the composite sandstones.

The distribution of the stones, which I have here specially mentioned, is not uniform over the earth's surface. Some localities have a great deal of good building stone, but many others have little, and some none. But there is scarcely a place where there are not deposits of silica, both on land and in water.

In stone for building purposes, there are very many qualities necessary to be considered, amongst which are—

First. Strength, compressive and tensile.

Secondly. Absorption of moisture.

Thirdly. Hardness, or capability of being cut and otherwise worked.

Fourthly. Structure, which may be compact and in even or uneven layers.

Fifthly. Fracture, upon being struck with a hammer, for it may be either straight or conchoidal.

Sixthly. Colour.

Seventhly. Chemical composition or resistance to acid-laden atmospheres.

The questions of strength, absorption, hardness, structure, fracture and colour are very easily settled, and, with regard even to chemical composition, it may be taken as a general rule that the majority of limestones and sandstones will stand well in country parts; but, in towns, where what I call superabundance of civilisation has accumulated, there these artificial conditions create artificial atmospheres, and few natural stones last long.

Reid, a great authority on the subject of natural and artificial stones and concrete, said, in 1879:—

"In England and Scotland, in widely separated districts, and subject to a variety of climates, is exhibited the instability of the most carefully selected stones. At Exeter in the West, Norwich and Ely in the East, Cheshire in the North West, and York and Chester in the North, are to be found Cathedral buildings from a study of which it will be seen that even the most favoured district failed to supply what may be regarded as a moderately durable building stone. . . . . The magnesian limestone — a hard crystalline everlasting looking stone—of which the Houses of Parliament are constructed and which was selected by a commission of scientific experts, gave practical evidence of premature decay to the same generation that witnessed the erection of the pile."

And now we have, from the annual report of the Chief Officer of the Public Control Department of the London County Council, issued in August, 1901, the following confirmatory statements:—

"Few building stones will stand the London smoke for any length of time, and the ordinary limestones, which are mostly used for building purposes, are found to decay very rapidly. Complaint has been made, from time to time, of the decay of Lambeth Palace and Westminster Abbey. . . . . In order to ascertain whether this could be attributed to hydrochloric acid fumes, I had analyses made of portions of the decayed stone. The result showed that only a very small percentage of hydrochloric acid or its compounds was present; certainly not more than the normal percentage found in similar stone in other buildings in towns. In addition to this, I caused an examination to be made of about a hundred old stone buildings in various parts of London. It was found that nearly all these buildings also showed signs of decay almost as serious as those at Westminster and Lambeth. Having regard to these facts, it is reasonable to infer that the decay of these buildings cannot be specially attributed to fumes from the Potteries."

Rivington, on "Building Construction," Hall, on "Building and Ornamental Stones," and other authorities entirely concur, and should be consulted.

The reason of the decay of natural building stone is given in Dobson's "Rudiments of Masonry and Stone Cutting," based upon the report of the Parliamentary Committee on the Houses of Parliament, as follows:—

"Under normal conditions the changes produced on stone must be ascribed to the action of the oxygen, carbonic acid, nitric acid, and water in the atmosphere. In towns, however, more especially where there is a large consumption of coal, other constituents of a far more destructive character—several acids of sulphur, and occasionally hydrochloric acid—exert an almost irresistible disintegrating influence:—

And the subjoined analyses, also given by Dobson, and likewise based on the aforesaid Parliamentary report, plainly justifies the reason.

It will be seen from the Table that the generally used stones are either principally composed of carbonates, or that the indestructible silica is cemente dtogether by carbonates. Most sand stones are, however, very durable, but expensive.

The question which modern builders have had to face is, therefore, one turning more on the chemical composition of stones than on any other point; and, as reliable stone for town buildings has become more and more scarce and expensive, attention has, for over hal century, been turned to the study of the che cal composition of natural stone and manufacture of a good artificial substit It also being evident, from centuries of ob vation, that silicate of lime had proved best of all known cementing substan special attempts have been, from 1832 till n made to manufacture a silicate of lime stor

Typical Stones.	Carbonate of Lime.	Carbonate of Magnesia.	Oxide of Iron and Allumina.	Silica.	Water.	
Limestones—						
Barnack	93·4	3·8	1·3	—	1·5	t
Chilmark	79·0	3·7	2·0	10·4	4·2	t
Ham Hill	79·3	5·2	8·3	—	2·5	t
Ancaster	93·59	2·90	0·80	2·0	2·71	t
Bath Box	94·52	2·50	1·20	—	1·78	t
Portland	95·17	1·20	0·50	—	1·94	t
Ketton	92·17	4·10	0·90	—	2·85	t
Dolomites—						
Mansfield Woodhouse	51·65	42·60	—	3·70	2·5	
Bolsover Moor	51·1	40·2	1·8	3·6	3·3	t
Roach Abbey	57·5	39·4	0·7	0·8	1·6	
Huddlestone	54·19	41·37	0·30	2·53	1·61	
Park Moor	55·7	41·6	0·4	—	2·3	
Sandstones—						
White Mansfield	26·50	17·98	1·32	51·40	2·8	
Craigleith	1·1	—	0·6	98·3	—	
Darley Dale	0·36	—	1·30	94·40	1·94	
Heddon	0·8	—	2·3	95·1	1·8	
Kenton	2·0	—	4·4	93·1	0·5	

Dobson, writing on the subject, says:—

"The ancients, in the preparation of the mo they used, seemed early to have discovered the m of counteracting the destructive action of the atr phere, and, after 2000 years, Roman mortar app to have undergone little or no change. Silicat lime seems to have secured to it its great durabi . . . . Silicate of lime has long been adopted to r the influence of the atmosphere, and also the ac of the sea water."

And Reid writes:—

"From what has been said it must be apparer all engaged in building operations, that in the fu more attention must be paid to the fabricatio artificial stone, on whose durability perfect confid can be placed."

The enquiries and experiments made, h I may here remark in passing, been not in the direction of artificial stone, but als that of washes for natural stone. Very fe these latter are, however, very effective durable, or cheap. The principal one is cate of soda; and lately Professor Chur from six to twelve applications of bar

[hy]drate—first in the form of spray, and then, [aft]er a few days, with a brush. This remedy [ap]pears effectual, but it must cost a great deal [in] labour and in scaffolding.

[I]t not being, however, my intention to go [de]eply into this collateral subject, I will [pa]ss on to an account of the efforts made to [pro]vide good and cheap artificial stones.

[R]anger's patents, dating as far back as [18]32, mark the first step in the manufacture of [art]ificial stone. His method was to mix sand [or] silicious material with caustic lime, slaking [wit]h hot water and ramming the plastic mass [int]o mould boxes. Later, he used the aggre[ga]te hot, securing better combination by that [me]ans. There are, I understand, several [lar]ge buildings now existing which were con[str]ucted with stone manufactured under [Ra]nger's patents. His theory, and that of [ma]ny who have followed him, was that the [lim]e would combine chemically with the silica [an]d form silicate of lime. Chemical authorities [ha]ve, however, always been antagonistic to [thi]s view, and it is generally conceded now, [tha]t caustic lime and sand merely mixed [tog]ether with hot water, or even subjected [to] immersion in hot water for considerable [tim]e, do not combine chemically.

[T]he Frear artificial stone, used for a time in [the] United States, was a mixture of hydraulic [lim]e and sand, together with a certain portion [of] gum shellac. This latter ingredient was [add]ed for the purpose of hardening the block. [Hy]draulic pressure of 15 to 25 tons was applied [to t]he wet mixture when it had been deposited [in t]he moulds. In what manner the pressure [wa]s utilised, and what was the exact intensity [per] square foot, I have not been able to dis[cov]er. The smaller blocks were ready for use [f]rom three to four weeks. In this case, the [hyd]raulic lime would contain a certain per[cen]tage of durable silicates, which would [dou]btless give to the stone considerable [stre]ngth. The addition of the gum shellac, [whi]ch accelerated the induration in the first in[sta]nce, was probably the cause of the dete[rior]ation which ensued afterwards; at any [rat]e, the stone soon became decomposed, some [aut]horities attributing it to the shellac, and [oth]ers surmising that imperfect lime was the [cau]se. Reid, already quoted, is very dubious [as t]o the value of gum shellac, used with any [ma]trix. Two other American processes may [her]e be mentioned—Forster's and Van [Deb]urgh's. In both instances, moist sand [wa]s used, but Forster used slaked, and Van [Deb]urgh unslaked lime as the matrix. The sand was employed moist, the inventors being under the impression that every particle of moist sand would become evenly coated with lime paste, and no void spaces left. As a matter of fact, lime does not mix well with sand, under such circumstances, the moisture tends to make the lime "ball," and adhere in small lumps. To secure a perfect mixture, both sand and lime must be very dry. Van Deburgh further used steam to assist the slaking, and also agitated the mass for some time. Afterwards the blocks were subjected to percussive pressure. Van Deburgh describes, also, various other methods of making stone. He mentions the use, as a matrix, of an alkaline silicate, and also proposes keeping the mixture in vacuo, during the formative period, to prevent the creation of carbonate of lime by combination between the carbonic acid of the air and the caustic lime; which action (he supposed) would interfere with the production of silicate of lime. Ordinary "water glass," silicate of soda or potash mixed with a suitable quantity of lime, should, under suitable conditions, form a silicate of lime, the soda or potash being rejected. The difficulty has always been to get rid of the rejected alkali, because so long as it remains in the stone, moisture will be attracted and induration retarded—60 or 70 days are required for the induration of stones made with alkaline silicates; and, unless the blocks have been carefully and frequently washed with clean water during that period, they will still effloresce, whenever they come in contact with moisture. It may be concluded that the difficulties and expense attending the manipulation of such mixtures were too great, as apparently, none of those alternative processes were ever carried out on a practical scale.

A similar process was that of M. Sorel, a French chemist. The matrix in this case was calcined magnesian limestone, which was used in a manner substantially similar to that which Ranger adopted with ordinary lime. There is, however, great difficulty in calcining this class of stone, because a much higher temperature is required (1,700° Fahrenheit) to drive off the carbonic acid of the carbonate of lime (which usually forms from 15 to 65 per cent. of the bulk), than is necessary in the case of the carbonate of magnesia (700° Fahrenheit). Consequently, if the magnesia is properly calcined, the carbonate of lime has to remain unaltered, and forms an inert proportion of the whole

and a source of unreliability in the ultimate product. This difficulty alone would probably account for the permanent want of success which attended M. Sorel's efforts. Apart from this, however, it has been discovered that compounds of magnesium are not always to be relied on to withstand the action of either foul air or moist atmospheres or immersion in sea waters. All these inventors relied, to a great extent, in their practical operations, on the theory that silicate of lime or magnesia could be formed by merely mixing the materials together and treating them in the various ways described. The failure of their products discredited this theory for a time, and a number of so-called chemical (as contrasted with the above rather mechanical) processes were subsequently developed and attained a fair measure of success.

We now come to one of the ablest investigators of the subject, Frederick Ransome, whose earliest patent is dated 1855, and his latest 1875. Ransome's stone and slight modifications of it have been made until quite recently, and there are buildings in London and the country which testify to its enduring qualities. Ransome's method was to create a silicate of lime in a mass of sand or pulverised chalk, by first mixing the material with a soluble silicate, usually silicate of potash or soda, and then immersing the mass repeatedly in chloride of calcium or any other solution capable of decomposing the silicate. By this process silicate of lime is formed, and chloride of potassium or sodium is thrown off, giving rise for some time to an objectionable efflorescence, which must be washed off and will cease when the chemical interaction ends. Various improvements in this process have been patented, chiefly with the object of saving labour and securing better saturation of the blocks with the chloride solution. The blocks have been placed under vacuum and the solution introduced, either with or without pressure, and sometimes hot. Various forms of chambers have been devised in which to manipulate the mass economically, but apparently, although this product is excellent, these processes involved so much care in the preparation of materials that they failed commercially.

Sir H. Bessemer's and E. L. Ransome's patents in the United States of America, describe the use of a vacuum chamber to assist in drawing the cementing solution into the mass. And further modifications of the system known as silicating may be illustrated by a reference to another Unit States patent taken out by the same M Ransome. In this case an attempt is ma to avoid the expense involved in the dire use of the silicate of soda or potash matrices, and also to improve the uniformi of the product. Silica, lime, chalk, hydraul cement, and other lime substances, in a fin divided state, are saturated with a solution caustic soda or potash, or of carbonate soda or potash; the object being to create t silicates in the mass, instead of having to i troduce them afterwards.

Rudolph Zuber, in his German patent, d scribes an apparatus designed to extract t air from the component parts of the sto before mixing. He points out the difficulty otherwise obtaining an absolutely solid mixtu Water, he says, contains a certain amount air, and to drive this off he boiled it. T presence of air in artificial stone before co solidation is most detrimental to its streng and durability. "Hair cracks" are forme and moisture laden with elements of corrosio is introduced into the body of the stone. winter the moisture freezes and the block split into fragments. These hair cracks al reduce the mechanical strength, by lessenin the cohesion of the mass.

Up to about 1885 little advantage seems have been taken of the property of caust lime to expand considerably when slaked. F limes expand from 2 to 3½ times in bul and hydraulic limes from 1 to 2 time Dr. Zernikow, in his German patent 1885, describes the use of this proper of lime, and he is really the pione of all the modern methods of makin artificial stone. The lime and sand we mixed together dry and rammed into a stro mould box. They were then subjected to t action of steam or hot water for a considerab period. The first result of the contact wi moisture was of course the slaking of the lim and its efforts to expand being checked by t mould, they resulted in considerable conso dation of the mass. After the slaking w completed, the steam or hot water, it w claimed, slowly created silicate of lime in t block. A pressure of steam of only about thr atmospheres or 45 lbs. per square inch w used. The time occupied for the comple process was from four to seven days.

Owen, in 1894 and 1896, describes modi cations of this procedure. He specifi hydraulic lime, evidently because the f limes were found unsuitable for a proce

iich involves continuous immersion in water. stilled water is also used to avoid the introction of any air into the moulds during the ıking period. The pressure (60 lbs. per uare inch) is kept up by means of a pump, stead of by steam (as in Zernikow's patent), d through a coil. In the earlier specifition a claim is made that the hydraulic essure external to the mould box will counterlance the expansive force of the lime within. nce, however, the moulds necessarily permit e water to enter for the purpose of slaking e lime, it is difficult to see how this can be e case. This process occupied about from to 70 hours. Hydraulic lime, if of good iality, only expands to about twice its bulk hen slaked. Consequently, the consolidation the block wlll be less than in a case where a t lime is used.

It was found that large blocks of artificial one are liable to crack if dried and cooled too iddenly after manufacture, by the process st described. Drying and cooling devices ere, therefore, protected by Bush in 1895, id by Owen in the United States, in 1897. In 1other English specification in 1896, Professor hompson describes a process in which steam ly is used as an amalgamating agent. He aims the formation of silicate of lime by mply subjecting the mixture of sand and iustic lime to the action of steam at a presire of three to five atmospheres, but chemical ithorities have decided that silicate of lime is t formed under such circumstances, and the tended experiments made by me have demonrated that steam alone will not properly 'drate lime, and that the product is weak id unreliable. Further, to obtain the maxiım slaking effect, it is essential that the ne be hydrated as quickly as possible. The iter and plastic processes do not secure this rfectly, and the steam process occupies hours. find that if the slaking takes place slowly, ere is a tendency to solidification on the surce of the blocks before the centres have come hydrated.

Christian Heinzerling, in the German patent 1897, improves on the methods of Zernikow id Owen. The dry mixture of sand and lime placed in a mould, and then the air is hausted previous to the operation of slaking. e also specifies the use of carbonic acid gas an auxiliary amalgamating agent—presumly to create carbonate of lime as a matrix. iis gas is introduced after the slaking has en completed, and is immediately preceded the creation of a second vacuum around the mass. If the block is as solid as it should be, there will be little use in attempting to exhaust air from it, and the carbonic acid gas will only be able to attack the skin.

Here ends my review of previous efforts to make large blocks of stone, but before I pass to my own work in that direction, I must add something about artificial stone bricks, otherwise called sand-lime bricks, for, when the Germans failed to make large stones, they gradually came down to producing these bricks, which have now become a most extensive industry all over the Continent, whence it is spreading to America and other places, and it is being inquired about even here. The English are generally slow to take up new things, but when we do, I think we soon outstrip the others. At any rate, in this case I, as an Englishman, am pleased to say that, not only have I mastered the long unsolved stone problem, but, also, that my son has produced a far finer sand-lime or stone-brick than any I have yet seen. How this came about constitutes, as some one writes, the "Romance of the silicate of lime stone industry."

In 1894 I lent a sum of money on the silica mine in Wales, where my parent works now are; and, in 1897, I was asked to take the mine over in settlement of my mortgage. I did so. Then, believing I had got a very valuable material, I looked about for some use for it, tried, through experts, making Dinas fire-bricks, and failed; and then, hearing of Owen who was making a silicate of lime stone at Woking, I sent an engineer and my son to see into it, found it was just the thing, as we thought, that would utilise my silica and lime quarries, and at once started experimentally. Succeeding very well on a small scale, I consented to my engineer erecting a large factory; but, when it was up, not one single stone could be produced of any size without cracks all over it. Being disgusted, I dismissed the engineer, went to Owen's, and found he had shut up from the same cause. I also travelled on the Continent, and found there, too, the same results. I then saw that if I went on, and overcame the difficulties, I should have something really needed all the world over, and I thought a couple of thousand pounds more would easily cover the cost. But instead of spending only that amount I went on and on for nearly four years and spent altogether about £34,000. To do this I kept on realising always at a loss, until I had to resort to mortgaging, and it was only

when I was at the very end of my resources and did not know how to continue that I discovered the solution of the problem. After fully satisfying myself that I was right I opened an exhibition here in London last year, and with some difficulty formed a syndicate, by the aid of which I have taken out patents in the principal countries of the world and followed up my discovery with great interest, for its reception all over the world has been most pleasing, and I trust now that I shall be able to depart this life some day leaving behind me an example of what can be done if one has a firm reliance on a Loving and Wise Creator, and does not mind enduring loss and hard work for the sake of serving one's fellow creatures.

The great value of the industry lies in the following points :—

1. The stone itself is a production of a true silicate of lime stone—the old Roman mortar which has stood so many centuries.

2. It is not a concrete made with Portland cement, and is absolutely homogeneous throughout, and can, therefore, be cut up and used like—nay better than—natural stone, which has layers, vents, flaws, &c.

3. It is better than natural stone; because few natural building stones now used will resist the acids in the atmosphere, and this stone does.

4. Silica sand exists on over three-fourths of the earth's surface, and is, therefore, obtainable near building sites, and thus an immense saving will ensue in carriage alone.

5. There are immense tracts of land where no natural building stone is obtainable; and, therefore, where this is the case, the chance of obtaining stone by my process is a fact of immense importance.

6. In addition, the stone may be produced at about 3d. per cubic foot, a price at which natural stone cannot be quarried.

7. The carving qualities of the stone are splendid.

8. The crushing strength is three times greater than Portland stone, or less if desired.

The undoubted value of the stone is already being proved by the hearty testimony of architects and builders throughout this country and abroad, and by the many orders which are coming in.

As is usual, and I may say essential, for great success, my discovery is of the simplest possible, so that any ordinary mechanic, with a fair amount of brains, can learn and carry out the process, which is, shortly, this :—

We use nothing else but ordinary silica sand (as most sands are) and common fat lir The purer the sand, the purer and better stone will be, and ordinarily we prefer not have more than about 3 per cent. of iron a 3 per cent. of alumina and no other forei matter. But I may say here that stone can made by us out of almost any sand and qua refuse, but it would not always be a p silicate of lime stone. In some places th would not matter, but in large cities the pu the stone the longer it will endure.

The sand we grind and grade so as to several grades, and the lime is reduced to very fine powder. The two ingredients, in t proportion of about 92 per cent. of sand 8 per cent. of lime, are mixed dry, and then r into a cylindrical mould, made in a spec way and this is the key to the proces The mould is closed, and placed in a boil from which the air is then exhauste and into which water is immediately aft wards allowed to enter and cover the moul The temperature is gradually raised to abo 350° Fahr., and kept up for eight hou when the process is complete. The boiler allowed to cool, then opened, and the mou removed. When cool enough the mould is r lieved of its contents, which can at once used. I call the process absurdly simple; ar yet it has cost, if we reckon the thousands ea attempting inventor has spent since 1832, he and abroad, a couple of hundred thousar pounds I suppose. The process is a clo imitation of nature's methods, for in th bowels of the earth we find silica sand, alk lies, and a high temperature, with an eno mous superincumbent pressure.

In conclusion, I will repeat a favouri assertion of mine, already made, namely, th when civilisation creates artificial condition simple natural things have to be replaced b artificial products.

DISCUSSION.

The CHAIRMAN thought the paper was an e tremely interesting one, which gave a very concis history of the work which had been previously done o the subject. The author had attacked the questio from the point of view of the practical man, while h (the Chairman) looked at it from the point of view c the chemist. He was sorry that a little more chemistr had not been introduced into the paper, especiall with regard to the composition of the new stone. I the artificial manufacture of stone materials, tw chemical questions arose. The first point might b to obtain a silicate, but a pure silicate would probabl be a great deal too hard for cutting purposes, an

ıld only be used in the form of bricks. In the ıufacture of large masses, therefore, one would e to try and obtain a silicate which had a certain ount of softness in it,—a silicate which corres- ded as nearly as possible to the fine sandstone ıd in such quarries as Craigleith, or Giffnock, in tland, which, he thought, contained practically the est quantity of silica in sandstones. That was one of making the stone. Secondly, another process urred in the hardening of such materials, viz., formation of aluminates in conjunction with ates, which took place more in the forma- ı of cement bodies. It was a pity chemists not looked more fully into the changes which k place in the gradual formation of such bodies; rtain amount of chemistry was known about it, much was vague and uncertain. It would extremely interesting if more analyses could made of the stone described, and a series of in- tigations carried out at different times during the cess of manufacture. Apparently, from the short cription given, the stone was manufactured in an eedingly simple and cheap manner. As far as he lerstood the process, it seemed to him that there ht be both a partial chemical combination in the ıufacture of stone and a partial mechanical dening. He could quite understand that partial mical combination might take place if lime s mixed, in a very finely compressed state, with d, and heated in presence of moisture under ırmous pressure, but he did not think entire mical combination would. He did not think mixture could be entirely converted into a cate under those conditions. From what was ıwn of silicates, they required enormous tempera- e, but apparently that circumstance might be dified by pressure. It would be interesting to e a systematic analysis made to ascertain whether re was any evidence that the bases which had been d in the manufacture of the stone had formed tinct silicates. In the hardening of the stone there ht be a partial silication.

Colonel ALAN CUNNINGHAM thought the author l given a very interesting history of artificial lding materials of a certain kind, but he had itted any mention of the most ancient artificial lding material, common brick, which became so d and durable that it might be called an artificial ne. There was no question as to its durability, re being many instances of Babylonian bricks of most excellent quality. He supposed that no terial, whether brick or natural or artificial building ne, could be a really permanent material in a ıntry subject to frost, if it was porous; while in a t country the same principle applied, because when absorbed moisture in the little crevices that were all natural stones, organic materials were liable to t in. In tropical countries the same effect took ce from vegetation as happened in cold climates m frost, and porous stones, cement or mortar failed for these reasons. Another point which had interested him was the comparison made between the author's stone and the old Roman cement, Mr. Ford saying that his stone was like the best of the old Roman mortar in being a silicate of lime. It was not within his recollection that old Roman mortar was a silicate of lime; he would like to be informed on that point; but it was not exposed to modern town atmospheres, so that it seemed to him doubtful whether the old Roman mortar would have been durable under such conditions.

The CHAIRMAN, in reply to Colonel Cunningham, said the brick was a fired stone. In the manufacture of the author's stone he imagined great economy was found by the fact that it was made in the cold, except for the blowing in of the steam; there was no expense of heating. With fire, a silicate was made under any circumstances.

Mr. WALTER REID said he had analysed several specimens of Roman mortar, and it certainly was not made with silicate of lime, and did not contain any appreciable quantity of it at the present time. It was thoroughly carbonated on the outside, and its hardness was chiefly due to its great age. The same remarks applied to modern mortars. He took down a railway bridge of Brunel's not long ago, and the ordinary lime mortar was excellent, and as hard as the brick. When one considered that the subject of the paper was artificial stones, brick or terra-cotta ought to be included, because to compare a new material with an old one which did not stand, such as limestone, was hardly fair; it should be compared with a material which was known to stand, such as terra-cotta, which was being more widely used in constructional work in large towns. With regard to the formation of silicate of lime from sand under the conditions named by the author, he would like to get an analysis of the product and find out how much silicate of lime actually was present in the stone; but, so far as his experiments went, he did not think there would be any appreciable amount of silicate of lime formed, especially when the sand was a quartz sand. With a sand composed simply of flint the case was difficult; an appreciable quantity of silicate might be obtained, which being on the surface of the grains of the flint, was in the best position for cementing them together. The percentage of silicate in a stone was not the only thing; the point was where that silicate was situated—whether it was in the best position for cementing the grains of sand together or not. The claim that the stone was a close imitation of nature's methods could, he thought, hardly be upheld; it was exactly the reverse of nature's methods. Nature did not produce building-stone in that way, because the whole of the building-stones which had been mentioned were not silicates of lime. He knew of no natural silicate of lime stone which was used on a large scale for building purposes;

the only one which contained any appreciable amount of silicate of lime was the Kentish rag-stone, which was used to some extent; but if an old building containing rag-stone was examined it would be found that the silicate of lime had gone, and the grains of sand in it remained on the surface to some extent, and it was the sand in a great many of such stones which preserved the mortar. It would be found that old Portland cement concrete was being protected by the sand grains which were held on the surface, and in sea work that was always the case. Pure Portland cement would not stand at all in a sea, but if a large quantity of sand was mixed with it the sand grains for a time would preserve the cement. If stone was used as well durable work was obtained. The French would not use Portland cement; they preferred the natural lime, because of the large percentage of silicate in the Portland cement, which was soluble in sea water. He would like to know in what way the author's process differed from the one which was very largely used in Germany at the present time. Was it the increased pressure or increased temperature, because both high pressure and high temperature were used now in Germany on a large scale. A great many artificial stones had been mentioned, some of which were very good. Ransome's stone was at one time largely used, but it was expensive, and after a time an efflorescence appeared on the surface, which corroded the surface of the stone, and buildings made with it looked very bad indeed, and there appeared to be no remedy for it. He would like to know what evidence the author had of the durability of the stone, which was the important test. He would very much like to have some chemical evidence on the point, because without it no satisfactory judgment could be formed.

Mr. H. Bridgewater stated that he recently went over the author's factory, and saw stones weighing ten tons made. That was a very great advantage. The essential difference between the stone, as manufactured by the author, and under various German processes, was that Mr. Ford's were made in a cylindrically shaped vessel, and this was the key to the success obtained; the pressure exerted was not even unless the vessel was cylindrical. He had seen some chemical tests made, with the result that while the ordinary stones effervesced, the action of the acid on the author's stone was scarcely perceptible. Mechanical tests which had been made also proved its wonderful durability.

Mr. E. C. Thrupp said he had been instructed to make an independent investigation of the author's stone from an engineer's point of view. Having carefully gone into the question, he could state positively that the manufacture of the stone did not involve a very great capital outlay in relation to the output, and there was no doubt that the material could be turned out and sold at an excellent profit for considerably less than any other stone which was available on market in London at the present time. The sa remarks applied to its manufacture in Paris. He not think the author did himself justice in the desc tion of his process. The cylindrical mould was essential point of the success of the stone, ma factured in large pieces as compared with the o processes. Every metallic mould was necessarily some extent, elastic, and when pressure was put u it by the expansion of the material inside, so portion of it would give way if it was not cylindri The slackening off of the pressure in certain directi led to the failures of the square and other sha moulds, but the cylindrical mould gave a unif pressure in all directions, the elasticity of metal exerted its pressure evenly all round, a therefore, the tendency was to produce a unif product. The Chairman mentioned the t perature and the pressure at which the mate was produced. The temperature was 350° Fa but they could not tell what the actual press was, because it depended on the actual ste pressure, or water pressure, contained in vessel where the operation was carried o and a pressure was obtained acting upon material and the pressure in the boiler, plus pressure due to the expansion of the mater He did not think the author had yet arri at the precise value of the extra pressure due to expansion of the material; that would be arrived later on by careful measurements of the expansion the metal, and the sectional area of the metal, a calculating the exact pressure from the kno elasticity of the metal. Chemists would t be able to draw their own conclusions as whether a silicate of lime ought to be produc and give some further information as to w pressure and temperature should be arrived in order to get the best result. The author had produce a material which could be worked; it w not his object to produce something so hard that could not be cut. The present demand for stone w not so much for building pyramids and cathedrals for commercial structures, and something must produced which suited the majority of users.

Mr. Ford, in reply, illustrated by means of d grams how the cracks and other defects due to use of the square form of box had been overcome the use of the cylindrical shape. Another diffic was the temperature. None of the preceding mak had used more than 60 degrees. He first went to 90 degress, and, finding there was no impro ment, he used higher temperatures, with disti improvement, and by means of the increa temperature and the absolute evenness of press the desired result was obtained. There w an absolute combination of the silica with lime. The Chairman had said he did not beli he obtained a conversion of all the lime and sili He did not; if he did, such a hard stone would

oduced that it could not be used. Analysis showed at out of 95 per cent. of sand, 78 per cent. was left; per cent. was converted into soluble silica and lime mpound, whereas only 5 per cent. had been t in, so that 3 per cent. of the lime had en converted, and some of the silica. For all actical purposes they were combined sufficiently to ake a matrix, so as to combine all the articles well gether, with the result that an absolutely homoneous mass had been obtained. When the experients were first commenced, if a section of the stone as examined one could see where the silicate ended d the lime began; now one could not, they were tually fused together. His first licensee, Mr. Brand, Perth, took a piece of stone made of his own sand his own land, and gave it to a gentleman who had frozen sixteen times. After each freezing he put on the stove and made it red hot; and the stone now on exhibition in Glasgow, as a monument the durability, so far as freezing was conrned. In his journey through Germany, he sited Andorf, on the Kiel Canal, which was built tirely of badly-made bricks composed of local nd, and that city was a monument of how such aterial would stand the severe frosts prevalent that part of the country. With regard to bricks, s son had, within the last three months, produced a ong and absolutely crystallised brick by a variation the stone process; it cost next to nothing extra, d it would be of immense value. The full zed brick averaged 8 lbs. in weight. The stone he had oduced was practically $2\frac{1}{2}$ times as hard as Portland one, crushing at 690 lbs. compared with 270 lbs. for e very best average Portland stone. He did not aim exactly that the stone was a Roman mortar, t Dobson claimed that the strength of Roman ortar was due to the presence of silicate of lime; d if his stone, by analysis, was shown to be silicate lime, he thought he had a good claim for saying at he had successfully approached to the Roman ortar. Terra-cotta was a durable article, but it was pensive and some people did not care for it. With gard to durability, his argument was that silica was destructible; the only thing that would touch it was drofluoric acid: lime also was in universal use, and these two could be chemically combined, the result ust be better still. He had exposed in London, stones ade in the original boxes in 1898, and they did not ow the slightest signs of decay. Many experts had bjected the stone to strong acid atmospheres in their boratories, without any result, whereas other stones d shown signs of decay. Its porosity was as low as at of any natural stone, being about 8 per cent. mpared with about 17 per cent. for Portland one. It was less porous than most sandstones, d being absolutely homogeneous right through, ere were no flaws and cracks in which vegetation acids from the atmosphere could be deposited.

A vote of thanks was accorded to Mr. Ford on the otion of the CHAIRMAN.

Obituary.

C. J. GALLOWAY.—Mr. Charles John Galloway, for many years active member of Galloways (Limited), boiler makers and engineers, of Manchester, died suddenly on Monday, 14th inst., in the seventy-first year of his age. He had the entire superintendence of the construction of the viaduct carrying the Furness Railway across Ulverston Sands, and subsequently he was interested in the Manchester Ship Canal Company, of which he was a Director until his death. Mr. Galloway was a patron of art, and gave the commission to Lady Butler (then Miss Thompson) which resulted in the production of "The Roll Call." On learning the desire of Queen Victoria to possess this picture, he surrendered it to Her Majesty. He rendered valuable assistance to the British Commission in several international exhibitions, and his firm provided the motive power for driving the machinery in the British Section, at Paris, in 1878 and 1889, and at Chicago in 1893. He also assisted in the series of Exhibitions held at South Kensington in 1884, 1885, and 1886. In 1887, he took part in the origination and management of the Manchester Royal Jubilee Exhibition. Mr. Galloway was elected a member of the Society of Arts in 1890.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock:—

MARCH 23.—"The Rural Housing Question." By T. BRICE PHILLIPS. The LORD BELHAVEN AND STENTON will preside.

Papers to be read at meetings after Easter:—

"Lessons to be Learnt from the Fire Brigade Appliances at the late International Fire Exhibition." By EDWIN O. SACHS.

"Early Painting in Miniature." By RICHARD R. HOLMES, C.V.O.

"Agricultural Education." By J. C. MEDD.

"Motor Cars for popular use." By MERVYN O'GORMAN, M.Inst.E.E.

"Statistics of the World's Iron and Steel Industries." By WILLIAM POLLARD DIGBY.

"The Need of Duty Free Spirit." By THOMAS TYRER.

INDIAN SECTION.

Afternoons, at 4.30 o'clock:—

THURSDAY, MAY 12.—"British-Grown Tea." By A. G. STANTON.

TUESDAY, MAY 31.—"The Economic and Industrial Progress and Condition of India." By J. E. O'CONOR, C.I.E., late Director-General of Statistics India.

Colonial Section.

Tuesday afternoons, at 4.30 o'clock :—

March 22.—" Cotton Growing in the British Empire." By Alfred Emmott, M.P. The Right Hon. Sir Edward Grey, Bart., M.P., will preside.

April 12.—" The Regeneration of South Africa." By Ben. H. Morgan.

May 3.—" Canada and Great Britain." By W. L. Griffith.

Applied Art Section.

Tuesdays, at 4.30 or 8 o'clock :—

April 19.—" The Sentiment of Decoration." By Alfred East, A.R.A.

May 17.—" Pewter." By Lasenby Liberty. Sir George Birdwood, K.C.I.E., C.S.I., will preside.

Cantor Lectures.

Monday evenings, at 8 o'clock :—

Bertram Blount, F.I.C., " Recent Advances in Electro-Chemistry." Three Lectures.

Lecture III.—March 21.—The electric furnace — Calcium carbide, carborundum, graphite, fused quartz—Carbon disulphide—Phosphorus, iron.

MEETINGS FOR THE ENSUING WEEK.

Monday, March 21...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. Bertram Blount, " Recent Advances in Electro-Chemistry." (Lecture III.)

East India Association, Westminster Palace Hotel, S.W., 4 p.m. Mr. W. Hughes, " Madras Irrigation and Indian Irrigation Policy."

Surveyors, 12, Great George-street, S.W., 4 p.m. Discussion on paper by Mr. H. J. Elwes, " British Timber and its uses."

Geographical, University of London, Burlington-gardens, W., 8½ p.m.

Camera Club, Charing-cross-road, W.C., 8½ p.m. Mr. C. Robbins, " A Peep at Prehistoric Man."

Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p.m. 1. Rev. Canon Garratt, " The Samaritan Text of the Pentateuch." 2. Rev. Canon Hammond, " The Samaritan Passover of the Present Day."

Tuesday, March 22...SOCIETY OF ARTS, John-street, Adelphi, W.C., 4½ p.m. (Colonial Section.) Mr. Alfred Emmott, " Cotton-Growing in the British Empire."

Royal Institution, Albemarle-street, W., 5 p.m. Mr. L. A. Wallis Budge, " The Doctrine of Heaven and Hell in Ancient Egypt, and the Books of the Under World." (Lecture II.)

Medical and Chirurgical, 20, Hanover-square, W. 8½ p.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. 1. Discussion on following papers: (*a*) Sir Robert Hanbury Brown, " The Use of Cement Grout at the Delta Barrage in Egypt"; (*b*) Mr. George Henry Stephens, " The Barrage across the Nile at Asyut." 2. Mr. Leopold Halliday Savile, " Lowering the Sill of the Ramsden Dock, Barrow-in-Furness." 3. Mr. Robert Henderson, " Burntisland Harbour : Constructi[on] of the East Dock."

Wednesday, March 23...SOCIETY OF ARTS, John-stre[et], Adelphi, W.C., 8 p.m. Mr. T. Brice Philli[ps], " The Rural Housing Question."

Chemical, Burlington-house, W., 4½ p.m. Ann[ual] Meeting.

Geological, Burlington house, W., 8 p.m.

Naval Architects (at the House of the Society [of] Arts), John-street, Adelphi, W.C., 12 a.[m.] Annual Conference. 1. Address by the Chairm[an] the Earl of Glasgow. 2. Sir Edward J. Re[ed], " The Battleships *Triumph* and *Swiftsure* [(] Chilian *Libertad* and *Constitucion*)." 3 L[ord] Brassey, " Merchant Cruisers and Steams[hip] Subsidies."

Royal Society of Literature, 20, Hanover-square, [W.,] 8½ p.m.

Thursday, March 24...Naval Architects (at the House [of] the Society of Arts), John-street, Adelp[hi,] W.C., 12 a.m. 1. Sir William H. White, " [The] Establishment of an Experimental Tank [for] Research Work on Fluid Resistance." 2. M[r.] R. E. Froude, " Some Results of Model Expe[ri]ments." 3. Professor A. Scribanti, " The Heeli[ng] and Rolling of Ships of small initial Stabilit[y."] 7½ p.m. 1. Herr Otto Schlick, " Gyrosco[pic] Effect of Fly Wheels on Board Ship." 2. Mr. [J.] E. Thornycroft, " Some advantages of Gas a[nd] Oil Engines for Marine Purposes." 3. Mr. A. [E.] Evans, " Internal Combustion Engines for Pr[o]pelling Small Vessels."

Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Society for the Encouragement of Fine Arts, Suffolk-street, Pall-mall, S.W., 8 p.m. [Mr.] Todhunter, " A Stroll through Hertford-house."

Royal Institution, Albemarle-street, W., 5 p[.m.] Dr. Sidney Lee, " Shakespeare as his Conte[m]poraries knew him." (Lecture II.)

Electrical Engineers, 25, Great George-street, S.W[.,] 8 p.m. Messrs. K. Edgcumbe and F. Pun[ga,] " Direct Reading Measuring Instruments [for] Switchboard Use."

Camera Club, Charing-cross-road, W.C., 8½ p.[m.] Mr. F. Enock, " Illustrations of Insect Life."

United Service Institution, Whitehall, S.W., 6 p.[m.]

Friday, March 25...Royal Institution, Albemarle-stre[et,] W., 9 p.m. Prof. Dewar, " Liquid Hydrog[en] Calorimeters."

Civil Engineers, 25, Great George-street, S.W[.,] 8 p.m. (Students' Meeting.) Mr. J. M. Kenne[dy,] " The Relative Advantages of Continuous a[nd] Alternating Current for Traction Purposes."

Naval Architects (at the House of the Society [of] Arts), John-street, Adelphi, W.C., 12 a.m. [1.] Professor A. Rateau, " Steam Turbine Propuls[ion] for Marine Purposes." 2. Dr. J. Bruhn, " So[me] Points in connection with the Transverse Stren[gth] of Ships." 3. Mr. A. W. Johns, " Normal Pr[ess]ures on thin Moving Plates." 7½ p.m. 1. M[r.] A. C. A. Holzapfel, " Ships' Composition." [2.] Mr. Edwin O. Sachs, " Fire Prevention on S[hip]board."

North-East Coast Institute of Engineers and Sh[ip]builders, Westgate-road, Newcastle-on-Ty[ne,] 7½ p.m. Mr. H. M. Wilson, " Automatic Gove[rn]ing of Marine Engines."

Clinical, 20, Hanover-square, W., 8½ p.m.

Physical, Royal College of Science, South K[en]sington, S.W., 5 p.m.

Saturday, March 26...Royal Institution, Albemarle-stre[et,] W., 3 p.m. Lord Rayleigh, " The Life and W[ork] of Stokes " (Lecture VI.).

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FRIDAY, MARCH 25, 1904.

[All] communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

CANTOR LECTURES.

[M]r. Bertram Blount delivered, on Mon[da]y evening, 21st inst., the third and last [lec]ture of his course on "Recent Advances in [Ele]ctro-Chemistry."

[A] vote of thanks to the lecturer for his valu[abl]e course of lectures was passed on the [mo]tion of the Chairman.

[T]he lectures will be published in the *Journal* [dur]ing the summer recess.

COLONIAL SECTION.

[T]uesday afternoon, March 22nd; The Right [Ho]n. Sir Edward Grey, Bart., M.P., in the [cha]ir.

[T]he paper read was "Cotton Growing in the [Bri]tish Empire," by Alfred Emmott, M.P.

[T]he paper and report of the discussion will [be] published in the number of the *Journal* [of] April 8.

[SO]CIETY OF ARTS MAP OF THE WORLD.

[A] map of the world has been prepared, [sho]wing the principal places outside the [Un]ited Kingdom, in which members reside, [an]d to which the Society's *Journal* is sent. [Th]e map has been produced by Messrs. [Geo]rge Philip & Son, Ltd., and indicates the [prin]cipal steamship tracks, through lines of [rail]ways, principal naval and coaling stations, [an]d the distances between the chief ports of [the] world. A copy of the map will be for[war]ded, post free, to any member who likes [to a]pply to the Society's advertisement agents, [Me]ssrs. Walter Judd, Ltd., 5, Queen Victoria [Str]eet, London, E.C.

Proceedings of the Society.

INDIAN SECTION.

Thursday afternoon, March 10, 1904; Professor Sir William Ramsay, K.C.B. LL.D., F.R.S., in the chair.

The Chairman said it was his pleasant duty t[o] introduce to the meeting Mr. Frank Birdwood, wh[o] was about to read a paper on a most interesting subject. Sir George Birdwood, his father, lived in India for many years, was a well-known botanist, and knew more about many characteristics of th e country and people than did most natives, an d certainly most Europeans.

The paper read was—

CHINA GRASS: ITS PAST, PRESENT AND FUTURE.

By Frank Birdwood, B.A.

The Past.

The fibre which to-day is commercially known as China grass has been famous since times "whereof the memory of man runneth not to the contrary." Mentioned in the Chinese classics, it was named among the articles of tribute in the reign of Yu (B.C. 2205); the Chinese Herbal asserts that nothing was know of its origin, lost as it was in the mists of antiquity, while Virgil too, it is suggested, had China grass in his mind, when he wrote

> "Quid nemora Aethiopum, molli canentia lana?
> Velleraque ut foliis depectant tenuia Seres?"

Assuming that the Seres are the Chinese, the people of Eastern Asia (it is interesting to note that Lucan, when talking of the mystery of the sources of the Nile, places them near those springs, and makes them the neighbours of the Æthiopians) the "fine fleece" is generally held to be silk; while Fee, in his "Flore de Virgile," maintains that the trees referred to are cotton. If we turn to Pliny, we find references in Book IV. c. 20 (17), in Book VII. c. 2 (1), and in Book XI. c. 27 (33) which clearly demonstrate that he and the Romans of his time were perfectly acquainted with the silkworm and the cocoon, with the manufacture of silk, and also with all the attributes of silk and cotton and their respective sources, while his references to "down from leaves" and to other textures and "Seric tissues," notably in Book XXXIV. c. 41 (14), Book XXXVII. c. 77 (13), and Book

XII. c.21 (10), would appear to refer to a fibre other than silk or cotton, and there is a certainly plausible force in the theory that, having regard to the fame of China grass throughout the East, it was to the fabrics produced from that fibre that Pliny was alluding.

Leaving what amounts to speculative history, and such casual references as may be found in the writings of Marco Polo and others, and before passing to the story of the modern movement towards the treatment and manufacture of China grass, it is necessary to say a few words as to the plant which produces the fibre and the methods by which the stems are induced to yield up their wealth. Speaking very loosely, China grass is the fibrous strip peeled from the stem of a stingless nettle (*Boehmeria nivea*). All the nettles, I believe, are fibrous-bearing, and from the ordinary stinging nettle (*Urtica dioica*) an excellent yarn can be spun, as witness what Hans Andersen says in "The Wild Swans":—"Do you see this stinging nettle which I hold in my hand? A number of the same sort grow round the cabin in which you are sleeping . . . you must pluck them . . . By treading upon them with your feet you will obtain flax . . ."

It is unnecessary to deal with the botanical questions which have been raised from time to time concerning the actual species from which China grass is derived; the question is highly technical and somewhat vexed, and it may well be that one species is only a geographical variety of the other. China grass doubtless is obtained from *Boehmeria nivea*, and also, without doubt, *B. nivea* cannot be grown in certain tropical regions where an allied species, *B. tenacissima*, appears to take its place. The object of this paper is simply to show that, if the Chinese grass has a commercial use, it must follow that if another plant allied in species can be grown in other regions to produce a fibre identical with that contained in the better-known variety, such fibre has a commercial use too. The manufacturer wants fibre, and it is with fibre that the planter has to supply him, and as long as they carry on the work in a businesslike way, neither of the principal parties to the arrangement need worry themselves concerning botanical terms. Though of course, in the preliminary experiments, as will be presently shown, it is essential that samples should be extracted from both species before it can be proved that the product of each is of equal value.

There is one other general matter which to be touched upon, and that is the nam the fibre. The hand-stripped, hand-scra stems which are imported from Shanghai commonly known as China grass, and the product of the locally named chu-ma, being a generic term embracing many variet including kin-ma, with its yellow flowers with stalks which, when dipped in sulphur, used as matches, cloth and sandals be made from the fibre; ta-ma, which is emplo in the manufacture of cloth and ropes, its fi being used as a support for the pith in candles; luh-ma known to rice-bag manu turers; tu-ma and pi-ma for paper. In Ass and Cachar the plant and its products known as rhea, and in the Straits Settleme as ramie. Both rhea and ramie are freque imported without the outer bark being moved, and in that state usually are descri as "ribbons." For the purposes of this pa China grass, or simply "grass," will incl all fibrous strips, whether scraped clean or while the yarns and threads will usually be ferred to as ramie, that being the name un which they are most generally known Europe and across the Atlantic.

In order to obtain the fibre, the stems w they have attained maturity (the methods cultivation will be dealt with later) are and the Chinese labourer (generally a wo or a child) strips off the leaves with a bam knife, placing the stems in cold or tepid wa according to atmospheric temperature. wand is then broken across the middle, which means the fibre-bearing bark is loose and raised from the stalk. The finger-n are thrust into the interstice thus formed, it is a simple operation to separate the f from the stem. To scrape the fibrous st very primitive implements are used; the w of the bark is removed, however, and results after being exposed to sun and n dews for a day or so, are sorted accordin colour (the whitest being selected for the f cloths) are brought down the river from country districts to Shanghai, paying a so what shameless "squeeze" on the and ultimately find a market under the n of China grass. The estimates of the am of fine grass capable of being turned ou each worker vary—the maximum daily we quoted is 10 lbs., and it is stated that the of production does not exceed £12 a ton.

In China and the East, as has been shown fabrics made from the fibre have been far for centuries, and it is hard to conceive

ıg more perfect than the diligence of the ives in spinning and weaving by hand the ːads, yarns, and materials necessary for ir purposes. The fibrous strips, while wet l with the gum still in them, are separated hand into the finest filaments, and the s are then twisted together to form a yarn able of being woven, while other yarns ı the gum extracted (the fibre in that con-on being known as filasse) are used in manufacture of the famous grass cloths. ɔes and shoe threads are also made of the ː, fishing nets and bow strings, while for ain ornamental purposes the threads, with gum in them, are dyed with indigo and a iant scarlet pigment, while the fibre is also l as a silk adulterant.

he staple of the fibre contained in China ;s being of exceptional length, ranging ı 2 to 24 inches, and of great strength brilliancy, it will be readily understood a fibre in such general use in the East, ng so many noticeable qualities, speedily ıcted the attention of European manufac-rs. It appears to have been sent to land first in about the year 1810, and ı813 the Society of Arts awarded its r medal to Captain Cotton, a director ıe East India Company, for his efforts in ging it into notice. Nothing much seems ıave been done for some years. In , we find certain samples were sent to Indian Government from Cachar and the ı States. In 1852, Major Hannay, who been actively engaged in an inquiry into fibre in Assam, was informed that certain bales which he had forwarded to London, the first which had been sent over, and als in India were told that there would be lifficulty in collecting capital to float a pany; but they were advised that it would est to go on quietly; that some initial loss : be expected, and that, as had been the with flax and hemp, it was for the larger ufacturers to see what could be done with new fibre. Government bestirred itself, n 1854 we find Bills of Lading for six ; of rhea fibre which were shipped by *John Bunyan*, from the Bengal Public ırtment; and that same year the Secre-to the Government at Bengal wrote to Commissioner of Assam to cause about ɔns of similar fibre to be purchased and ırded for shipment to England. It difficult to collect the whole amount, ultimately, some two or three tons were atched. Still further correspondence ensued, and in 1860, before the Society of Arts, Dr. Forbes Watson, whose name will always be prominently associated with China grass, ventured the prophecy "that the fibre from this and other plants of the nettle species will occupy a place second only to that of flax." In 1864 the Chamber of Commerce at Rouen published a report on China grass, full of the hope that in it they had found not only a rival but an ally of cotton. At that time the American war had brought about a crisis in the latter industry and an efficient substitute was being eagerly sought. The report in question makes genial reading, and the experiments of MM. Malard and Bonneau, with which it deals, appeared likely, in the words of the committee, "to form an epoch in the history of textile substances," the inventors being paid a compliment on "their neat and perspicuous style which rendered them intelligible even to those who are not at all accustomed to such investigation." The experiments in question had been carried on with so-called cottonised ramie, that is, the filasse (the gum-freed fibre) was cut into short lengths in order that it might be rendered capable of being spun on ordinary cotton machinery. According to the report, complete success in mixing was attained and also in bleaching, dyeing, spinning and weaving, the material being regarded as in reality a substitute for cotton, possessing also properties which are peculiar to itself.

The report of the Rouen Chamber of Commerce did not produce any immediate good, but undoubtedly the experiments were genuine, and, in the event of the price of China grass falling, the results declared to have been attained may be profitably retested.

These experiments and the work carried on by the Government of India, and the publicity which resulted, gave an impetus to the industry, but without exception, so far as the United Kingdom is concerned, the results were little less than disastrous. Government unfortunately jumped to the conclusion that because the fibre had been used in the East for centuries it could, therefore, be used in English factories; while, regarding supply, they were from the reports that had been laid before them led to the conclusion that as "(1) the China grass plant produces, when properly manipulated, one of the strongest known vegetable fibres" and "(3) in India there is unlimited extent of country throughout which the plant can be grown .... cheaply and easily" therefore "(4) although the merits of

the fibre have been well known for the last fifty years, and various attempts have been made from time to time by Government . . . . . to encourage the growth of this plant, and develop a trade in this fibre, all such attempts have failed owing to the absence of suitable mechanical appliances for the separation of the fibre and bark from the stem, and of the fibre from the bark, and of the great cost of effecting such separation by manual labour." Assuming (1) and (3) to be true, it unfortunately, with the light of more modern knowledge to guide us, cannot be said to be a fact that at that date the absence of a decorticating machine was the only bar to success. However, a Government prize was offered, the public desire was stimulated, and though the reward was never actually won (a consolation grant was given) manufacturers, apparently deeming that China grass, having gained as it were official countenance, must contain all the elements of success, without due thought poured their money into the new venture, and they lost.

It is unnecessary to deal with the various kinds of decorticators which were produced, or to detail the experiments which were carried on. Among the rules of competition a fibre had to be produced which would realise a certain sum per ton on the London market. This alone would have prevented any chance of successful result, for such fibre would be quite unlike anything brokers had ever handled before, and it was hardly likely that it would fetch a prize even approximating that of China grass. But the offer of a prize had a still further unfortunate result—it tempted manufacturers to erect spinning works, before they knew how to extract the gums, or whether or not the clean filaments were capable of easy treatment and successful spinning on existing machinery. Also company promoters entered the field, and, as samples of fine white lustrous sliver could easily be produced, the public mind became inflamed and yet more money was squandered on absolutely worthless experiments. The difficulties in degumming and manipulating the filasse into a seemingly perfect yarn were overcome by degrees, but then the market had to be found, and here again were difficulties. The fibre is stubborn and the earlier methods of degumming left much to be desired, and, accordingly, yarns and fabrics of a character which would at once be condemned by any ramie manufacturer to-day were offered for sale. Failure followed fast on failure until ultimately China grass and its yarns became a byword of reproach amo the English manufacturers and the investi public—fortunately it has been given as it w a burial-ground of its own, and this fa seeing that occasionally it was possible extract truth from some of its epitaphs, h mainly contributed towards the success to-day.

The Present.

Step by step over the footprints of those w had failed before them a way towards fortu has been won. The difficulties were gre but when things came to be looked at quiet it was found that, prejudice apart, there w but little to be achieved before success w attained. And a survey of the work actua accomplished in England in recent years w prove it. The problem facing the manufa turer was three-fold: (1) supply, (2) prepar tion, and (3) market.

With regard to *supply*. For the mome we will only deal with the raw product exported from China. In Europe, a co siderable quantity is used every year, b England only takes a small percentage the whole; Japan is the principal purchas China to-day has a virtual monopoly, and my opinion, having regard to the market co ditions which during the last few years ha proved a very pointed lesson to manufacture it would be mere madness to start an Engl business on large lines, that is a factory turn out many tons a day, floated with the intent of competing all along the line with ot fibres in general use, and at the same ti dependent for its supply on the Celes merchant, unless through some arrangem with the local Mandarins it had been able contract ahead for its raw material. A sm company, working special lines, compet with particular articles, and treating thousand tons or so of raw material ev year, could complete its purchase with materially affecting prices, and there are g profits so to be earned. But if anyone thinking of investing capital, let him see t the output of the business is sufficiently sm to remove all fear of enhanced price of raw m terial, and sufficiently large to meet a swamp dump from fibre rivals. It is essential t some other source of supply should be fou so that by competition market prices may regulated.

As to *preparation*. The form in wh China grass is imported into England, been explained. Now, this raw material

› one-fourth, is a so-called gum, while three-›urths are pure fibre. The first process is to :move this gum, but before dealing with this · any other process of decortication, treatment, · manufacture generally, I must express my ıdebtedness to Mr. Phillippson, without whose elp it would have been impossible for me to cquire the knowledge necessary to enable me › treat of the subject of China grass at all. : is Mr. Phillippson's patient labours which ave overcome the difficulties which have foiled any others in the past; he has taught me any-ıing I may know, and the credit of achieved ıccess is his. The degumming is accomplished ı certain parts of India and the East, either by ·tting (which probably has a weakening effect, ıd is a lengthy process), by boiling in soda, · even by heating in warm sea water. In urope there are many processes—some paten-d, other secret—possibly an honestly thought ıt and worked out trade secret is the only secret ·ocess worth having. Let no one invest in ıy new process which has never been worked, ıd which claims to excel all known inventions. simply means that the inventor possesses e elements of knowledge, and that he has ·gun so many years behind everybody else. bove all, be not tempted by samples which e most evil snares. I have handled the oducts of many processes and they all go to ove that the difficulties of degumming are of e past. French and German and English stems differ in detail, but they all produce od strong marketable filasse of about equal ›rth—and each firm is contented with its n, not because it necessarily thinks its own e best, but because time and use have oved its capability. And, therefore, no ramie inning firm ever willingly offers a price for a re treated by a strange process. The test of ıe is the only guarantee of reliability.

After having been degummed and dried, ificially or otherwise, the filasse has to be ·pared for the comb by being opened out d the fibres made parallel to each other. :re again practice is the best patent. Cer-n of the machines are protected, but, :aking generally, as in the case of de-mming, the trade secrets are the most uable of any. If it had not been for the entor success would never have been won, d there is value and credit in the result ıieved by him, but the general conclusion be drawn from a China grass spinning fac-y is that it is the innate knowledge of the ails of the whole process from start to sh rather than individual patents that constitute the true worth of any such business. To-day every process can and must be completed under one roof, and for the moment all patents are at a discount; the value is in the brains which hold the trade secrets, for when all is said and done the manufacture of China grass is only just emerging from the experimental into the commercial stage.

The filasse when duly opened out has next to pass through the comb in order that the shorter fibres, *i.e.*, the noils, may be extracted. These noils are sold separately, and are either mixed with wool and made into blankets (their strength and washable qualities render them valuable as allies to weak wools, while the hairiness of the fibre renders the mixing complete), or spun pure and manufactured into a variety of fabrics.

In the next process the top or sliver which passes from the comb and which contains 66 per cent. of the total filasse (33 per cent. having gone off in noils) has to be prepared for roving, and the fibres have to be carefully parallelised. The machinery is not particularly novel, but great care is necessary, for ramie is stubborn, it is not easy to extract all the so-called "ribbony" pieces in the comb, and any carelessness leads to difficulties in the spinning. From the roving it is unnecessary to follow the yarn any further in detail. It is spun and hanked or skeined, doubled or balled and finished as the case may be. The processes are all perfectly simple and offer no difficulties to a practical manufacturer who has handled the fibre from the earliest stages and by experience has grown accustomed to its ways.

Before leaving the spinning and dealing with the ultimate products it is necessary to say just one word concerning the size of the yarns into which China grass can be spun. Some state that it can be spun into 100's (cotton count), by others 70's cotton are described as the finest yarn which could be made from it, and in one case the company which was to be formed proposed to spin nothing but that count. Personally I find that it is not easy to spin a really satisfactory yarn finer than 40's cotton, though certainly 60's could be made. One is, therefore, rather led to think (I hope wrongly) that the people who have asserted that it can readily be spun up to 100's have not had practical bulk experience.

Dyeing and bleaching offer overcomable difficulties while a perfect finish is not to be acquired without practice; but the way has been cleared, and the samples which are on

view and which are not museum specimens made up specially for the purpose of floating a company or pleasing a crank, but are from the bulk, amply prove that. They have all been made from yarn spun under a process with which I am conversant, and I vouch for their genuineness. There have been difficulties to overcome and complaints to meet, but the fact remains that the sales are increasing, and that repeat orders are placed daily.

With these facts in evidence, it is not difficult to understand why, in spite of the gloominess of the past, hope can be read into the future. Commercial success is undoubtedly within reach of the China grass manufacturer; he has had to wade through mud to grasp it. The cultivator was the first cause of failure; he saw that the price of fibre was high, the market was declared to be certain, and he rushed in to produce. Failure was a foregone conclusion, for Chinese methods and Chinese labour were neglected elements of success. But the verdict went out that China grass was not a payable crop. Next, the manufacturer was bitten with the madness—what the Chinaman could do he could do, and so, sans process, sans experience, sans machinery and sans market he poured out his wealth by the lapful. Failure was a certainty, and China grass was again condemned. The company promoter and the man with a patent to sell were busy in between and perhaps helped to make the mud a little thicker. Through all this time on the Continent, in France and Germany in particular, experiments were being steadily pushed along towards success, and they have won it. England now in a much smaller way has won her place too, but before the future is her servant some weighty problems have to be faced.

The Future.

In treating of the future, including *market*, the question of supply has first to be considered. To-day, as has been shown, the only raw material containing the required fibre commercially imported into this country is China grass, and the danger of violent market fluctuations have been discussed. This being so it is necessary to look to other countries for supplies, and the question at once is asked, "Where can the ramie plant best be grown?" In a paper read before the Indian Section, presumably it is not permissible to wander beyond the confines of the Dependency, but perhaps I may be allowed to state that the plant has been successfully grown in Jamaica, the Curator of the Botanical Gardens being able to repor most favourably upon it in 1857; that in 186 experiments were being carried on in Americ in Louisiana, and the conclusions arrived a were that the plant could be very easily an profitably cultivated, that in the same yea a report was made to the Colonial Secretar that the plant throve well in the Botanica Gardens at Trinidad, while in the Mauritius Sir Henry Barkly reported that the plan would grow rapidly; that in the Straits Settle ments, where the plant grows freely, the com ment was made that there seemed but littl chance of establishing its cultivation, unles the Government first showed that the experi ment was likely to succeed by cultivating small patch of an acre or thereabouts, as wa done by the Indian Government in the case o tea; that in 1872, in the negotiations concern ing China grass going on between Lor Kimberley and the Government of Natal, th latter wrote, quoting a letter from the Surveyor General, in which His Excellency's attentio was earnestly called to the fact that risk attending the growth of this fibre (amon others set out in the Report) from atmospheri vicissitudes and the ravages of insects, are nc of the same serious importance as thos peculiar to the cotton plants; that in Chin and the East the plant is freely cultivated, an in the province of Sechuen a large commerc is carried on in it, while in Yunnan its produc tion is extensive, and in Cochin China it grow wild; that it is stated to be indigenous t Singapore, and is cultivated in Penang, whil it is widely spread throughout the Far Easter Archipelago.

We will pass on to India. Experiment there were carried out from an early date, an in 1849 we find Dr. Macgowan sending ove some seeds and sample leaves from China wit somewhat quaint Chinese results. "They (th seeds) vegetated in the Botanical Gardens an turned out different from the leaf specimens the latter having been derived from *Boehmeria*, while the seeds have yielded hemp." The whole history of the various experiment in cultivating the plant in India have bee dealt with by Sir George Watt, and a referenc to Agricultural Ledger No. 15 will give suc information as the general reader may require In Sir George Watt's view the area of *commercial* production in India will probably b restricted to the submontane track lyin between Rungpur and Bogra in the south, an Kangra in the north. This and the questio of cost of cultivation is a matter, however

which the planter alone can decide. That t can be grown freely in certain parts of the Dependency is certain; large consignments f "ribbons" have been exported from that ountry in the past, and a fair quantity f Indian grown and treated fibre has been andled recently, and yarns and threads of nedium quality have been produced. This tter "grass" was machine stripped, and if the bre it contained had only been sufficiently ood in quality there is no doubt but that a eady market would have been found for the raw naterial, notwithstanding that it differs greatly n appearance from the ordinary China grass f commerce. Unfortunately the major poron of it had undoubtedly been cut too late, he stems had lignified and the fibre mostly as coarse and brittle. But in some of the bales was of fine quality and compared favourably ith average China grass, and it can fairly e inferred that if one bale out of ten showed ompletely successful results it only needs care nd patience to bring the whole parcel up to tandard. In fact one of Dr. Forbes Watson's ain arguments was that if the plant in its ractically wild state could produce so fine a bre it only needed cultivation to perfect it.

This point has been reached and the facts ted prove that a fibre-producing nettle (be it *oehmeria nivea* or *Boehmeria tenacissima*) n be grown in many parts of the world and India, and that the fibre to be extracted om that nettle is of commercial use. What mains to be proved is can it be grown in dia and be prepared for the market at a ofit? Many questions have to be considered; iefly, cultivation. It is impossible to lay wn hard and fast hypothetical rules; the nters in India are busying themselves in the tter and their experience is worth all the t-books ever written. A few references and ittle advice from the manufacturers' point of w may, however, help before we pass on to most important part of the planter's work, stripping of the fibre from the stems. One quently-quoted authority on the subject of cultivation is the "Imperial Treatise of inese Agriculture," translated by M. Stanios Julien and re-translated from the French. ose interested will find it set out at length Royle's "Fibrous Plants of India." Aner point to be noted is that the rhea plant very exhaustive to the soil, and in China ordingly the application of manure has n found to be necessary, but this may obtain to such an extent in India, ecially if the practice of returning the ash of the refuse stems is adhered to. In the "Journal of the Agricultural and Horticultural Society of India" (vol. i., part 4, 1870) stress was laid upon the necessity of good soil, shade, moisture, and manure. The "Indian Agriculturist" in 1896, was of opinion that "the soil that suits rhea is exactly what suits tea best, and nowhere does it flourish so freely as in low, well-drained ground, but it must be thoroughly well drained, for if water touches the root for even a short time the result is fatal. The plant will grow in any soil, but in order to get frequent cuttings, it must be rich and moist without being too damp. The "Kew Bulletin" of 1898, dealing with ramie as distinct from China grass, says:—"Both plants require good deep soil such as is to be found in alluvial soil in tropical countries. The climate should be warm and humid and without a prolonged dry season." In the "Indian Agriculturist" the advice is given that the best way of settling the question as to *nivea* or *tenacissima* as regards India is by cultivating under various conditions of climate or soil authentic specimens of each plant and by instituting a careful chemical and microscopic analysis of the fibres yielded by Indian grown plants of what are known to be true *nivea* and true *tenacissima*. The advice given by these authorities all point to one end, and if it is carried to its logical conclusion the Indian planter will be able at a minimum cost to ascertain whether the stems he is growing contain a marketable fibre, and he will be able still further to limit his risk of loss if he will only put himself at the outset in touch with the manufacturer who is his customer. What in the first case he should do is this. He should cultivate quite a small patch of the plant, and as soon as the stalks are ripe they should be cut, roughly handscraped, dried and baled, and remitted to the manufacturer in parcels of about one hundredweight each for his report. I would particularly urge it upon the planter carefully and scientifically to sort the stems and fibres, noting the date of growth and the length of the stems, so that it may be ascertained in which stems the fibre is to be found of the best quality. Having overcome the difficulties of cultivating, and being in a position to produce stems containing the right quality fibre, the question still remains:—Can these stems be grown at a profit, where is the market for them, and in what condition have they to be produced? In China, as has been shown, the fibrous strips or grass are obtained

by hand labour, and it is only because of the exceptional cheapness of such labour that the grass can be produced there at a profit. In India it has been suggested that manual labour would be available in sufficient quantities under certain circumstances, and in 1881 Messrs. Burrows, Thomson and Mylne published a pamphlet on the growth of the fibre by the people of India as a domestic industry, suggesting that the purdahnasheen women and girls could strip off the bark and complete the other necessary preparations at home, and they pointed out that, were this scheme feasible, a new industry would be introduced to a numerous respectable but needy class of people, and that it was probable that the production of India rhea fibre by such means would more generally benefit the people and the country than if it were in its early stages done by costly machinery. All this may be very true, but looking at things commercially it is impossible to imagine that machinery can ever be ousted by hand labour. If India is to depend on manual labour for a market for her native grown rhea, then it is to be feared that she will never take her place among the nations producing that fibre. Accordingly we are confronted with this alternative—a labour-saving machine or nothing. Can this machine be made, and the answer to that question happily is in the affirmative. From what has been said concerning decorticators it will have been gathered that the attempts in the past have all been with the object of proving that a machine can be made capable of turning out a material identical in all respects with China grass. It was to this end that Government offered a prize, and it is the object which every inventor has had in view. The danger of such a course is obvious and has been dealt with. Certainly with my own experience I have found that the machine-treated fibre, though it seemed quite as clean as or cleaner than ordinary white China grass, contained a larger proportion of waste, while it gave off a heavy percentage of short fibres in the comb—the fibre in fact had possibly been damaged by excessive scraping. Therefore, though I must not be thought to condemn any machine with a scraping movement, that is a machine which not only separates the fibrous-bearing peel from the stem, but removes its outer surface, what seems to be wanted is some apparatus which will free the strips from wood and pith, but which is not intended should have any particular effect upon the outer bark. The result would be practically brow "ribbons," that is the hand-treated fibro strips which have not been deprived of the outer bark. Some manufacturers apparent have been prepared to purchase these ribbo in the past, asserting that they can be easily treated as China grass and that they a infinitely cheaper. So far as treatment concerned, there is a very great danger injuring the fibres, for the bark hardens quite a remarkable manner, and it has to l removed somehow. And the statement th the manufacturer saves in cost is a fallacy, tl percentage of loss (apart from risk) being o of all proportion to the price of the ra material. Now any fibre treated by a machi producing brown ribbons must contain a hi percentage of gum, and, if nothing else, tl cost of freight would be unduly heavy. B a machine is absolutely essential, and tl scraping machines do not appear to do qui adequately what is required of them. Tl deduction is that the degumming process mu be carried out immediately after the ster have been cut and decorticated, when t gums are still moist, and all waste, includi bark, can be removed more easily even th from ordinary China grass, and in a w bearing no comparison to the risk entailed treating hard dry ribbons.

This point has, therefore, been reached— have seen that the Chinese can, at a profit themselves, produce an article for which the is a market; a plant capable of bearing fibre equal to that contained in ordina China grass can, it is certain, be grown many parts of the world, including Indi to prepare it in India machinery coupl with local degumming will be necessary; t process of degumming presents no difficulti As to profit, experience alone can answer th but the following facts may assist the cultivator at arriving at a conclusion. The app ratus required will comprise a decorticator a a degumming plant entailing the installat of a large kettle and certain tanks—the out on machinery of course being in proportion the output. The number of decorticat would have to be fairly considerable, for assume that cutting does not go on every d but at fairly definite periods. A mach capable of turning our some 350 lbs. of fibr strips a day would cost about £50. Proba in many estates, the motive power, boilers a vats, are at hand. Further, some drying sh will be required, but that is a simple inexpensive matter.

Leaving the cost of boiler and of labour out of onsideration, a few hundred pounds would be ufficient to instal a very efficient plant, while he cost of degumming, exclusive of rent and vages, should not exceed 25s. per ton. The ll-important question of weight per acre has o be considered. Here the experts are rievously at variance. Dr. Morris, lecturing efore the Society of Arts, stated that under ertain circumstances as to climate or latitude, rops would yield 15 to 20 tons of stem per cre, which would give ribbons (three-quarters o one ton) at the then ruling prices worth £8 er ton, the cultivation costing about £4 per cre. M. Favier estimated the output per cre at 1,400 lbs. of fibrous thongs. M. Joncet le Mas, in experiments carried out at Padua, ound that an average of 840 lbs. of fibre per cre was abtained. The report of the Special Committee of the Trinidad Agricultural Society, 897, gives the estimated out-turn per acre three crops per annum) at 7,200 lbs. of green tems, which is equal to 3,360 lbs. of ribbons, which is equal to 2,520 lbs. of filasse. Mr. Barraclough, who has also read a paper before his Society, stated that on an estate of 500 cres under good cultivation and favourable ircumstances with four crops a year, the out-ut was from 14 to 18 tons of green stems per cre per annum, giving from 1,500 to 2,000 lbs. f fibre per acre. In a Consular Report on amie cultivation in Mexico, 300 lbs. of fibre er acre were given. In the Kew Bulletin of 898, it was reported that from a small patch f China grass five years old, growing in e open air at Kew, it has been found that our square yards yield 100 stems, the weight of hese without leaves being 24 lbs., giving a eld of some 13 tons per acre; while at Venchow, China, an acre has been found to eld in one cutting 80,000 stems, giving 312½ s. of fibre, which would doubtless be the dinary cleaned China grass of commerce. he yield from the latter crop would, therefore, e at the rate of 937 lbs. per acre. Finally, in e "Gardener's Chronicle," in 1896, in a ote on rhea growing at Kew, it was stated at the average yield of stems was 20 per quare yard, weighing 4 lbs., and yielding 1¼ s. of wet ribbons, or 5 oz. of dried filasse. rom this it was calculated that one acre ould yield about two tons of dried filasse.

The figures are given as they are found—the iscrepancies have arisen mainly owing to the ct that the final product has in each case pparently differed; in some what amounts to oroughly cleaned China grass has been obtained, while in others the strips have retained all their bark and apparently some of their original timber. In stems too the yield varies in quite an extraordinary manner, and it is obviously impossible to draw any final deduction. Speaking generally it is considered that the yield of clean strips should approximate three-quarter tons per acre—at all events if care is taken and the plant properly cultivated over half a ton should easily be obtained in the course of the year. Being without figures and practical experience it is impossible actually to prove whether the plant can be grown in India at a profit and the discrepancies in the acreage returns from China grass render futile any comparisons with jute, cotton or hemp crops. But one thing is clear, if the fibrous strips can be produced by the cultivator at £20 per ton without loss, he will not have any difficulty in earning a dividend on his outlay—but not through sales at public auction, for once again stress has to be laid upon the fact that the crops will be machine not hand produced, and will resemble nothing on the market. The planter's production will in fact, at all events until the commercial use of ramie fabrics has become more general, be unsaleable except to the owner of the process by which the strips will be degummed, and who will alone be in a position to spin or dispose of the filasse. So here we have a planter producing a substance which we will assume it would pay him to grow, but with a one man market. The conclusion is obvious—the cultivator and the manufacturer must for all practical purposes be one—the agreement being that what one produces the other will take. The details of such a contract need not be discussed—it is plain that if there is a profit for both a mutual arrangement is merely a matter of time—the best would doubtless be one in which the manufacturer and producer were so absolutely the same that the question of price of raw material, so long as it was not produced at such a loss as to prevent profit on the sale of the manufactured goods, would not have to be considered for, if this was so, both parties would look to the ultimate returns and competition with low priced fibres would be made easier. That is by the way. The amount of capital required depends upon two considerations, namely, the minimum amount of crop which an estate can produce without loss and the minimum output on which a factory can be made to pay. So far as estates are concerned I have no definite

figures—roughly speaking, I am informed that an average of 24 tons of fibre per week would not be an over-large figure. That would mean some 1,200 tons a year, or about 2,000 acres under cultivation. The manufacturer producing 12 tons of finished yarn per week could do so at a cost of about 11d. per lb., with raw material at £24 a ton—24 tons a week would of course cost a little less to produce. The capital required for installation, and so on, would be large, but would compare by no means unfavourably with the cost entailed in the formation of an ordinary spinning business.

The question that has now to be considered is what *market* will the manufacturer's products find. The matter is theoretical, but looking at things soberly the future, though not free from difficulty, is fairly bright. The special attributes of China grass, yarns and threads, as has been stated, are their strength and lustre, coupled with the fact that, relatively speaking, they do not shrink, are very rot resisting, bleach well, and take a good dye. As against this is their stubbornness, which makes the spinning more difficult, renders the thread more liable to snap, and causes creasing in fabrics. In strength ramie thread is about 15 per cent. stronger than the very best linen, while it is rather more than $3\frac{1}{4}$ times as strong as the finest cotton; and the strength appearing in the yarns is naturally reproduced in the cloth. In lustre ramie is not equal to silk, and in dress materials and objects of that kind it can, in my opinion, never hope to compete with it. The lustrous dress fabrics made of pure ramie yarns stand indeed quite by themselves, having the appearance of neither silk, linen, nor cotton—there is about them a quiet, subdued brilliance, very beautiful and very distinctive — and owing to improved methods of spinning the creasing, which was a fruitful source of complaints in former days has been minimised—in fact it will always wash out, which was not the fact some years since, when permanent fracture remained. But in embroideries and furniture brocades where lustre, strength, and colour are required, but where intense softness is not a necessity, ramie will more than hold its own—in fact, it is not easy to distinguish between ramie and silk yarns in these fabrics. And the ramie will wash without losing lustre.

As against mercerised cotton, except where it is used in very fine spun soft goods, ramie is without a true rival, especially where the chemically added lustre merely enables the weaker fibre to be used as a silk adulterant or imitator, for such lustre is apt to be fleeting; while as an ally of ordinary cotton, the main value of the ramie is that it not only adds to the breaking strain strength of the material, but gives it a longer lease of life at the hands of the washerman. This latter attribute will appeal to Anglo-Indian ladies desirous of wearing cotton dresses in the tropics. As against cotton generally, ramie can never be a competitor, and, at present, the prices, except in treated cotton, render even an alliance impossible, but with an increased output that disparity will disappear. It cannot, it is true, be produced as readily as cotton, and it is certainly incapable of being made into as many fabrics. On the other hand, it possesses to a degree many qualities which cotton lacks, and, given equal prices, there is no doubt but that the two fibres could work in harmony, and to the benefit of each other. With flax, ramie will undoubtedly be a dangerous competitor, and it is not easy to understand the attitude of linen manufacturers. The ramie yarns are of as good or better appearance than the flax, and can be readily spun as fine as linen, and at cheaper rates. In lustre they are superior, they are stronger, and, being lighter, more yards go to the pound. In boot and saddlery threads (in which the first commercial tests have been carried out within the last few years in order to prove the strength and durability of the new fibre) ramie is doing all that linen can do, and to win a firm place in the market is merely a matter of time and price. In tablecloths and similar linen goods, machinery belting, canvas, and kindred purposes, ramie is bound to come to the front, and that front should be in advance of flax; it will outlast linen blind and sash cords, and window pulleys.

In non- or semi-competitive directions ramie also has a future, though it is somewhat difficult to-day to indicate what form the manufactures will take. As the basis of incandescent gas mantles it is used in very large quantities, and appears likely to supersede cotton; the manufacture of these mantles is chiefly Continental, and the ramie firms in Germany appear to have to cope with a steadily increasing demand. For underwear, ramie-made materials are increasing in favour; it is claimed for them that they possess hygienic qualities in a marked degree, and though personally I cannot quite endorse everything set forth in the advertisements, yet undoubtedly, in certain directions, ramie is as cool feeling as and yet more comfortable than wool, and I cer-

tainly should not care to wear anything else for boating and tennis and such like purposes. In khaki cloth, which to-day is made from cotton or wool, ramie is bound to command favour, especially for tropical wear—had it been in use in South Africa in place of the cotton khaki uniforms, though the immediate cost would have been more than doubled, the country would have financially profited in the end. In fact, an almost unlimited field is open to ramie manufactures, even if they do nothing more than win a way for their fibre in those particular places in which the better known yarns even in a measure, fail to fulfil all that is required of them.

Before bringing these remarks to a conclusion, perhaps it would be well to digress for a moment in order to consider whether the time is not ripe for further action on the part of the Government of India. The circumstances under which they originally offered a prize for a decorticator are open to criticism. A hard and fast price was fixed which the fibre had to fetch in the London market, and if this value was not attained, no prize was to be given. It stood to reason that an article similar in appearance to the China grass of commerce would not be produced, and, however excellent the fibre might have been, it would only be by practical tests that the quality of the constituent filaments could be ascertained. The prize was offered too soon, and the money possibly would have been better employed in fostering the scientific growth of ramie in India and in tests at home ; however, at that time, the cry for a decorticator was the vogue, and the money was wasted. To-day circumstances have changed, ramie goods are in commercial use in England and on the Continent, and other nations, Germany in her African colonies, Belgium in the Congo State, Holland in Java, are fostering the cultivation of the plant and the production of a raw material, which, whether similar to China grass or not, will contain a fibre which manufacturers will be prepared to buy. England lags behind and India and the colonies lag with her. To offer a prize to-day for a decorticator would do no good ; the policy must be wider than that. It will have been seen that there are two individuals with whom Government have to deal and not one—for to-day the manufacturer is part of the problem equally with the cultivator—it is on his verdict that the Indian product stands or falls. To-day China grass suffices his wants ; if its quantity could be increased, its quality kept up, and its price lowered he sees future and enlarged markets, but he will have to be tempted before he will stretch out even a finger to help India or the colonies unless they will help him, for China for the moment can supply his requirements ; and the Indian cultivator if he sees no market ahead is hardly likely to do anything or spend his capital on so dubious a venture. Meanwhile the competition from Continental aided cultivators will grow and India may find her market swamped.

Can Government help ? My humble submission would be this : Let Government say to the home manufacturer, "You are using ramie fibre and that fibre can be grown in India. If you will guarantee to take our Indian product to a given weight each year, we will guarantee interest on the capital spent in the erection of plant capable of treating this amount, and we will go further, and, if you can produce a thread or yarn or material comparing in all respects with other threads or yarns or materials now used by us and manufactured from other than Indian produced substances, we will undertake to give your goods the preference ; and further, having regard to the fact that India cannot grow 'grass' at a moment's notice, and that, therefore, you cannot complete your tests before the lapse of so many years, we will assume that your present products are made of Indian grown 'grass,' and will guarantee interest at such and such a rate from to-day against your undertaking to use Indian 'grass' when grown ; while if it is found at the end of the given years that it cannot be grown our guarantee will cease." To the cultivators Government would say, "An assured market awaits your products in England if you can show that you can grow the fibre to the requirements of manufacturers. To enable you to plant the necessary area and carry out the necessary experiments, we will guarantee some agreed interest on capital for a period of so many years, the undertaking on your part being that, if your experiments are successful, you will grow annually fibre of right quality to a given weight." It is hardly to be expected that, in the absence of a Government guarantee, the China market being as it is to-day, either the manufacturer or planter would take any steps to capture for India the China grass trade of the world. With such a guarantee, however, the necessary capital undoubtedly would be forthcoming, and, assuming the experiments to be satisfactory, a new industry profitable to India and England alike would result.

If the tale has been told aright the picture before you is this—you will have seen a fibre, apparently possessing all the elements of success, in daily use throughout all Oriental countries, and yet shunned in the Western world ; and its history will have given some of the reasons for its lack of popularity. China grass was left out or forgotten when other new fibrous substances leaped into sudden favour, and then, when manufacturers began to understand its latent value, they imagined that the difficulties, which in the case of jute for instance it took years to overcome, could be cleared away in a breath. This fallacy cost fortunes, and gave China grass a name of bad omen from which it is but gradually recovering, and the reckless enthusiasm of its supporters did the rest. China grass is the victim of the indiscretion of its friends. In their ignorant ardour they pleaded for it (and some still plead) that wherever silk or flax, cotton or jute, hemp or wool excel, ramie is their peer—and this with the past staring them in the face. It is with the object of tempering this foolishness that this paper has been written for as its friends exaggerate its virtues, so those who can see no good in anything new, or perhaps have lost money in China grass ventures, are lead to overblacken what they deem to be its vices. To those who have learned from the past, and who have a practical knowledge of the present, and, therefore, are confident of the future, it is plodding dogged work that appeals, for they know that much must be done before the dragon which guards the treasure is destroyed. This they know, too—let Hans Andersen give the augury—"It matters not being born in a duck's yard when one is hatched from a swan's egg."

DISCUSSION.

Sir M. M. BHOWNAGGREE, M.P., observed that the paper was highly instructive, excellently written, and showed a great deal of research. He congratulated the author upon his first appearance as a reader of a paper in that room. In Mr. Birdwood's father the Society had had, for a large number of years, a constant friend, who had furthered its interests, and enabled many members of the public to take benefit and instruction from the proceedings. He (Sir M. Bhownaggree) was greatly interested in the paper from the point of view that it might perhaps lead to the development of an important material product in India. He had, for many years past, advocated the industrial development of India, and one of the greatest difficulties he had found was, as to how to bring all those segregated ideas, that everybody sympathised with, into one common line, which mig lead to practical results. In the paper some ve practical suggestions had been made as to how t growth of China grass, or ramie, might be d veloped in India. He saw in the room many disti guished members connected with different depa ments of the administration of India, and he wish to leave to them the expression of more responsi views as to whether such bargains as the auth suggested might be struck between the cultiva and the Government on the one hand, and betwe the Government and the manufacturer on the oth could be put into operation. He, as a layman a non-official, looking at the subject only from t standpoint of India's industrial benefit, would e press the pious hope that it might be practicable Government to enter into some such arrangemen if that could further the development of the growth ramie grass. There was one passage in the paper whi struck him rather forcibly, namely, the quotation fr Hans Andersen : "Do you see this stinging net which I hold in my hand ? A number of the sa sort grow round the cabin in which you are slee ing. . . . You must pluck them. . . . By trea ing upon them with your feet, you will obtain flax That quotation, to his mind, had a very deep meani for India. There the people had got, growing rou their houses, over and under numbers of acres v valuable material. They looked at it, but did n pluck it, nor did they tread upon it so as to extra the good from it. The point which struck one mo was, what were the means by which people could got to see those things that grew round their h and in their villages ? What could be done to ma them pluck them and extract the good which w in them ? That was a large question which await treatment both from Government and the peop but, of course, he dare not enter into in det there. His point was, that there was a very lar field for the operation, both of the machinery Government, and for the desires and energies of t people of India, in that country where he believed mine of wealth undiscovered was still stored. many varieties of raw material which could be operat upon, India was absolutely a virgin field. He hop that before he and those present passed out of this li there would be a beginning made ; that the stage Government Reports and Society of Arts pape would be passed, and that the Government and t people of India would combine in the great comm cause of developing the country's resources, in rega to one of which the author had given such valuab suggestions.

Sir ANNESLEY C. C. DE RENZY, K.C.B., said had long taken an interest in the subject, and sor twenty years ago, in conjunction with his late frie Mr. Berry White, to whom Assam was indebted f so many useful suggestions and applications of scienc he had induced the Jokai (Assam) Tea Company, which they were both directors, to plant out sor

rty acres under rhea. It grew so luxuriantly as to ave no doubt that it could be produced in any antity in Assam, and at very moderate cost. The me-grown fibre has been used for a long time in e province as a material for making fishing nets, hich were said to be so lasting that they were handed wn as heirlooms from father to son among the shing craft. Mr. Berry White was very sanguine that time that the difficulties attending the decortiation and degumming of the fibre had been overme. Unfortunately he was mistaken in this, and the little experiment in the cultivation of the plant ame to nothing. Very large sums of money had en spent in decortication and degumming experients since, but with very disappointing results, ntil Mr. Birdwood took the matter up. He had ade great advances, and the prospects were most couraging, but in consequence of the past disappointments, it was feared that planters could not be duced to take up the culture on a large scale. He greed with Mr. Birdwood that to make rhea the sis of a great Indian industry the Government would ave to take the lead, and do for it what they did for a with such wonderful success. They would have to rse it over the difficulties which invariably attended e establishment of any new industry.

Major-General SIR OWEN TUDOR BURNE, .C.I.E., K.C.S.I., said he would like to support hat had been so well said, in thanking Mr. Birdwood r his interesting paper. Thirty-two years ago he ir Owen) was with Lord Mayo, who took a great terest in the question when forming the Agricultural evenue Department in India, in 1871, which had isted since and flourished. When the cultivaon of rhea in India was first decided upon, it was garded as far superior to China grass. Encourag-g reports of its strength were received, and those ports had been supported by the author. When it as manufactured it would, they were told, make t only strong rope, and so on, but also beautiful ky garments which would realise high prices all parts of the world. Lord Mayo's Government accordingly offered a prize of £2,000 for suitle machinery to manipulate the fibre. It was lt then, as Mr. Birdwood said that day, it must machinery or nothing, as far as India was ncerned. That £2,000 was not spent, because one produced a machine which could manilate the grass. He trusted that the Government would now take the matter up, believing and owing that in India there was plenty of ground for ltivating one of the best and strongest fibres in the orld.

Mr. THOMAS BARRACLOUGH said there seemed be a misunderstanding about rhea in India. The untry was growing more rhea than it ever did. India d not require the patronage of the Government in e matter; she would get on far better without it. ere were plenty of planters, and a lot of good suitable land. He had had visits from a dozen planters, who said they had 50 to 100 acres that were being put down in rhea. There also seemed a mistake about the decorticating. There was a decorticating machine so good that a company had taken it up in India, and was introducing it largely. The position and prospects of rhea were different to what had been described that day. The meeting was greatly indebted to Mr. Birdwood for all his care and research, because the more that was known about rhea, the better for rhea and the better for England. China grass must not be compared with anything else, because it was grown under peculiar circumstances. The peasants in China grew the China grass in their gardens, and it was a well established custom that the proceeds from it provides the wife and girls with clothing. They decorticated it themselves, and for that reason it was very cheap. With regard to the longer wear of things made with ramie, it was sometimes difficult to bring home such a thing to people. The German Government, which is always intelligently alive to everything touching its industries, and without red-tape, arranged that one of the Liners going to Australia should be furnished with table-cloths and all napery made of ramie. As a rule such things lasted two years on a large Liner, with its immense wear and tear; but the last he heard of the ramie goods on that vessel was that they were in full wear still, say seven years after, and they were looking so well and needed so little mending that they did not think any change would be required for several more years. A difficulty with ramie had been that if four or five fibres of it were put in the hand, they would each turn their own way; there was no affection among them. The fibre of ramie was a tube pressed into an oval shape. No great progress was made in spinning ramie until the idea was hit upon of softening it before passing it through the machinery. The method of softening the material employed had been improved each year; so that now ramie could be run through the machines at more than double the speed of ten years ago, and with only half the waste, namely 6 per cent. as against 14 per cent. That process of softening after degumming was of very vital importance in bringing the material to its present perfection. When opening a bale of ramie one got all kinds; but it ought not to be so. Unfortunately, the China fraud was beginning in ramie as it did in tea, and consequently, in a few years, China would not be able to sell its ramie. Formerly one could buy 100 bales of first-class China grass in China and find it was of first-class quality. But now they were pulling it by the roots instead of cutting it; and they were putting good, bad, and indifferent qualities into the bales. If the spinners had not been short of raw material, there would have been trouble over it before now. He saw some ramie the other day which had been paid for as first-class quality grass, but which was only third grade. Consequently, the opportunity for India to grow rhea was coming, for the same reason that its opportunity came for growing tea. He knew a man who was putting

down 1,000 acres of rhea, and the harvest would be reaped, because Chinamen were fraudulent. The machine he referred to was well known as Mr. Faure's patent. That gentleman got the gold medal in France, and the machine did the work splendidly. One could not, after it had passed through the machine, distinguish rhea from the best China grass. But it did not do enough in quantity, so the inventor set to work to improve the machine in the direction of increasing its production. It was now producing eight times more than it did before. Those who had the monopoly of the machine in India, possessed a very good thing, and it was transforming the trade, because, as had been already said, people would not go in for rhea unless they had the machine. There was no doubt that India was gaining in that material what it had lost in indigo, and England as a country would benefit by it. He was speaking to a Dutchman the other day who was putting down a large plant for spinning ramie in Holland, and he said he had bargains with more than forty planters in Sumatra and Java, and part of Borneo, all of whom were going to grow ramie, and some were already growing it. He believed the time was coming when China grass, *alias* rhea fibre, would become what it ought to be, one of the leading fibres, if not the leading fibre in the country. He thought that even in the next three or four years there would be a number of mills in England on a large scale. Underclothing was being extensively made from ramie yarn, and those who had worn it would wear nothing else. Again, ramie was being very largely used to mix with other materials; it was not in the nature of an adulterant, because it improved the material which it was mixed with. Silk and ramie sometimes looked more beautiful than silk alone. It was being spun up to No. 120 cotton counts to produce the finest lace and curtains which could be made. In Bradford, woolcombers and worsted-spinners were buying every ounce of ramie they could get, and, mixed with long wool it produced a peculiarly good effect. Bradford was doing more trade with America than any other town, and the mixture of their wool with ramie produced an effect for ladies' dresses which nothing else would give. He thought one might say that ramie, with all its trials and difficulties, had reached a flourishing condition, and one might hope to see great things from it in a short time.

Sir WILLIAM LEE-WARNER, K.C.S.I., desired to associate himself with Sir Mancherjee Bhownaggree, not merely in the deserved compliments paid to the author, but also in the earnest desire to promote the industries and commercial products of India. But he must detach himself from the pious wish expressed by Sir Mancherjee that Government should assist the production of China grass, and the conversion of it for the market, in the manner indicated by Mr. Birdwood. The State was justified in maintaining an Agricultural Department, in p moting exhibitions, supplying seeds, offering rewa for inventions, publishing facts, and maintain gardens or farms for experiments. But the idea taxing the ryot who grows foodstuffs, in order to others for growing grass, or in order to guaran interest to the manufacturer that he might suppl market which might refuse to buy, was really posterous. If the State took up one industry i particular product, it was sure to discourage ent prise in other methods of treating that produ Public servants might kill zeal, they could not cre it: and when they removed the stays given to a p tected trade the result was usually disastrous. A field and the minimum of Government interfere were the best aid to private enterprise, and t results of the operations of the congested Boards the West of Ireland showed clearly what mista and waste of money resulted from officials playi with commerce. The taxpayers' money would fruct better in the peoples' pockets than by being spent the fashion proposed by Mr. Birdwood.

Mr. W. MARTIN WOOD said that the Chairm would possibly be able to say why, from a mechani point of view, the application of rhea fibre on a lar scale was as yet insoluble. He thought Mr. Birdwo looked for too much at once. With regard to t suggestion that the cultivation of ramie might beco a domestic industry in India, he had always thoug if that could be followed up—it would be ine pensive—it would be a means by which the supply the material might be extended in India. Somethi might be done, not by the Government of India the sense alluded to by Sir William Lee-Warner; b through the district officers encouraging its cultiv tion, thereby enabling the ryots to profit by it. B necessarily the industry must proceed by degrees. T Chairman would be able to testify whether the d gumming difficulty had been overcome, a stage whi had not been reached last time the matter was di cussed. How was it with regard to the effect dyes? Some of the processes which had been us to decorticate and degum, were accompanied b chemicals which were found to have a deteriorati effect; and although the fabrics had looked ve well, they suddenly decayed. Certainly the shee and towels used on the Australian liner could n have been subjected to those chemical processes, those fabrics would not have thus demonstrated t inherent durability of the fibre.

Dr. JOHN POLLEN, C.I.E., said that in listeni to Sir William Lee-Warner defining the attitu which Government should assume towards th young industry, he was reminded of the famo utterance, "How good must be the Author of a Goodness" (*i.e.*, Government), and the quizzic rejoinder, "And oh, how green the Grower of a Grass!" He could not agree that Government shoul confine itself in a matter of this kind to merel

·rmissive or passive patronage. The growers of is grass deserved active assistance; and although : gathered from the remarks of Mr. Barraclough that e industry was beginning to make headway in rtain parts of India of its own accord—and on its vn merits—and did not need State aid, he thought was the duty of Government to take not only a rective but a dominant part in the development of ıscent or youthful and struggling industries such : this. What Government had done with regard to ıe encouragement of the tea industry had proved, ; declared by previous speakers, most beneficial, ıd what had been done for tea might well be done for ıea. Sir William had pointed to the failure of overnment in the congested districts of Ireland as reason for Government inaction in India. But in eland, what Government did was to encourage ·ople to catch fish without providing harbours or nding-stages or means of communication by which ıe fish, when caught, could be conveyed to market! ıdia could dispense with doubtful assistance of that ınd, but he (Dr. Pollen) thought much could be done ı the direction indicated by the author, with advan-.ge both to Government and to the pioneers of this ·w industry, and to the Indian ryot. This grass as not intended to supplant—but to supplement—›tton; and just as the Marconi system had been .ilised by the Belgian Government to supplement ·isting telegraph lines, so rhea might be used to ve greater endurance and more varied usefulness › cotton fabrics, and to stimulate the cotton industry.

Mr. RICHARD EDWARDS-RADCLYFFE thought it ould be a pity to let the occasion pass without ›inting out how much good could be achieved by ıe Government of India if it would help the industry. ermany was already subsidising its colonies and ith much benefit. He did not think the English ıould stand back and let the people struggle in ıshing an industry forward when others were being ·lped by a very strong hand. He did not think the ades should be indemnified from loss, and Mr. Bird-ood evidently did not mean that; but that those ıgaged in the industry should have the stimulus ising from the knowledge that the Government was ·lping them. One knew that ramie would be one of ıe most important fibres of the world. It had erits of its own, and should be allowed to find its ay on those merits. It should be made into the ings it was particularly adapted for, and then ·ople would "see that they had no other."

The CHAIRMAN said apparently subsidising indus-ies at their beginning was successful in America and Germany. One knew how America had subsi-sed the iron and steel trade, and what enormous nounts of those metals were produced there; how ermany had subsidised chemicals, and how the ade in small chemicals had gone to that country. e did not see why the Government of India should not subsidise rhea to begin with, and he had no doubt it would take a high place in the fibres of the world. With reference to the remark as to the utilisation of the ground on which indigo used to be grown, was it not possible that before many years artificial fibres would take the place of the natural ones? He had seen what was called artificial silk, but having no connection with silk, which was exceedingly strong and could be dyed beautifully. It was also apparently everlasting. A lady was wearing a blouse made of it, and she complained it would not wear out; she had already had it four years! Nothing seemed to fray out, and it seemed likely to last for ever; but it was questionable whether it was desirable for some things to last for ever. It would be an advantage for tablecloths and napkins, and for fishing nets, but it might not be thought desirable for articles of ordinary wear. But the cultivation of ramie should not be slackened because of the fear that artificial fibre would cut it out. Artificial fibre could be made from the same material and cost much less; it could be produced from trees useless for any other purpose. There were several questions which he had intended to ask Mr. Birdwood, but the hour was now too late.

Mr. BIRDWOOD said the samples of Indian "grass" which he showed were the product of the Faure machine. He read the portion of his paper dealing with that, which he had omitted owing to the pressure of time. He thought the Faure machine the best on the market, but he did not think it was the last word in decorticators. The one he had in his mind was a very simple one, and would do all that was required, and it was cheaper and worked much quicker. He also omitted the passage describing how the fibre was mixed with silk for garments. He had not been able to trace any decay in the yarns degummed during the last four years. About six year ago a hank of ordinary boot thread was tied round a tree near the river. At the end of four years it was taken down, and it was found to have lost less than 10 per cent. of its breaking strain during that time. With regard to standardisation, certainly directly the grass began to be produced in quantities the first thing the broker would have to do would be to fix standards for the market. Sometimes in the fibre imported to-day, the product would give 27 per cent. of waste, sometimes 22 per cent., yet they both looked about the same. It depended on the ultimate filaments. With regard to Sir William Lee-Warner's comments on the policy he (Mr. Birdwood) put forward, he had in his mind all the minor industries of India, feeling that, if practically applied Government help were forthcoming for them, a long step would be taken towards increasing the wage-earning capabilities of the population.

A vote of thanks to the author was carried unanimously, on the motion of the CHAIRMAN.

FIFTEENTH ORDINARY MEETING.

Wednesday, March 23, 1904; LORD BELHAVEN AND STENTON, in the chair.

The following candidates were proposed for election as members of the Society:—

Brinell, Johan A., Chief Engineer, Jernkontoret, Stockholm, Sweden.
Codington, Edmund W., The Polk County National Bank, Bartow, Florida, U.S.A.
Garlick, J., M.L.A., Adderley-street, Cape Town, South Africa.
Haig, Cecil Henry, 7, Eaton-terrace, S.W.
Martin, E. F., Royal Societies Club, St. James's-street, S.W.
Mather, Enoch, A. M., M.D., 80, Park-place East, Detroit, Michigan, U.S.A.
Pearse, Alfred, 14, Willow-road, Hampstead, N.W.
Phillips, John, A.M.I.Mech.E., Cornubia-house, Carlton-road, Nottingham.
Pote-Hunt, Richard, Plym-villa, Ward-road, Shanghai, China.

The following candidates were balloted for and duly elected members of the Society:—

Fleming, Dr. Andrew Milroy, C.M.G., Salisbury Rhodesia, South Africa.
Harvey, Robert, M.I.Mech.E., 27, Mincing-lane E.C.
Herzl, Dr. Theodore, 29, Haizingergasse, Vienna 18, Austria.
Keating, William, 42, Osborne-road, Stroud-green, N.
Lewis, John Thomas, Gas Works, Wellingborough.
Lort-Williams, John Rolleston, LL.B., 2, Paper-buildings, Temple, E.C.
Preston, John Roger, Yealand, Carnforth.
Tiffany, Frank, 3, Kelso-road, Leeds, Yorks.
Tipson, A. S., The Mitcham Japan and Varnish Company, Limited, 5, Bishopsgate-street Without, E.C.

The CHAIRMAN, in introducing the author, said that Mr. Phillips was already known to the members of the Society of Arts by an excellent paper on protection from fire published in March last year, which was awarded a prize by the Council.

The paper read was—

THE RURAL HOUSING QUESTION.

By T. BRICE PHILLIPS.

The Society of Arts has, for many years, taken a prominent part in devising and encouraging schemes, having for their object the improvement of the conditions under which the labouring classes are housed. In 1809 a premium of twenty guineas was voted to Mr. Robert Salmon, for a "Method of constructin[g] commodious houses with earthern walls,"* [a] method specially referred to in an "Essay o[n] Improving the Condition of the Poor," pub[lished] by Hatchard, in 1814. In 1864, the Bailey Denton Prize of £25 (and the Society's Silv[er] Medal) was awarded to Mr. John Birch, for th[e] best design of cottages for the labourin[g] classes,† whilst the recommendations containe[d] in the "Report of the Committee on Dwelling[s] for the Labouring Classes," issued in 186[?] anticipated some of the most important pro[visions] of the Public Health Act, 1875. O[f] more recent date is Mr. Edmund Wilson's paper, "The Housing of the Workin[g] Classes,"‡ in which the subject is reviewed i[n] relation to towns and congested areas. It is therefore, within the scope of the work of th[e] Society to examine the existing conditions o[f] housing in rural areas, to review the lega[l] enactments relative to the subject, and to con[sider] suggestions bearing upon the question.

EXISTING CONDITIONS OF HOUSING IN RURAL AREAS.

To give a general idea of the housing con[ditions] sometimes found in rural areas, it wil[l] be necessary to refer to insanitary dwellings and in justice to owners of property it shoul[d] be pointed out that the wave of sanitar[y] betterment which has passed over the countr[y] since, say, 1875, the date of the Public Health Act, has even reached remote rura[l] districts, as evidenced by improvements effected in those places. In this connection it is of interest to note that the President o[f] the Local Government Board has recently informed the Rural Housing and Sanitation Association that there has been a great im[provement] in the cottage accommodation in rural districts during the last twenty-five years in many parts of England, and that the exist[ing] laws, properly applied, are to some extent sufficient to meet the evils to which his attention had been drawn.

A reference to one or two cases, selected from many seen in the course of official inspections, will serve as an illustration to show that, notwithstanding these improvements, houses in rural areas do not always come up to the desired standard.

For instance, a small block of stone-built cottages is situate in a low-lying position

* "Transactions of the Society of Arts," vol. xxvii. p. 185.
† *Journal of the Society of Arts*, 110th Session, No. 598, vol. xii.
‡ *Journal of the Society of Arts*, No. 2,464, vol. xlviii.

'he approach is not made up, and in winter he site is little better than a swamp, for no rovision exists for the drainage of surface vater. These houses contain one living room, nd a small scullery, on the ground floor. In ome cases there are two, and in others three, edrooms on the first floor. The bedrooms re mainly in the roof, and the cubic capacity f the smaller ones may be gathered from the ict that a bed practically fills them. The lant of the ceiling commences at about two eet from the floor, so that a person has to stoop uite low to move about the room. In one oom of 250 cubic feet, ventilated by means of small window, four children were allowed to leep. In another similar house 13 persons vere crowded. The houses are dilapidated, re damp, have no drainage, and perhaps their ondition cannot be better described than in e phraseology of the Public Health Acts, as eing unfit for human habitation.

If the construction and general sanitary tate of the houses are deplorable, much more o are the conditions sometimes existing mong the inmates. A typical case was a ouse containing two bedrooms. In a small oom of barely 300 cubic feet capacity slept e occupier, his housekeeper, and one of her hildren. The remaining room, of 750 cubic eet, was devoid of furniture, except one ilapidated bedstead covered indifferently with irty bed-linen. At an inspection—a surprise isit—there were clear evidences that this om, with its one bed, had been occupied at e same time by two sons aged 23 and 12 ears, and two daughters aged 20 and 6 years espectively.

It would be difficult, in face of the admitted rogress made in sanitation, to account for ich a state of things, if it were not known that onomic conditions of a special nature exist country areas.

The prevailing features in rural districts are e dearth of cottages suitable for agricultural bourers, and the slight prospect of the arcity being met. As a consequence, ouses are occupied, which on sanitary rounds might be condemned if there were a ifficiency of accommodation elsewhere.

The general cessation in the erection of ttages suitable for agricultural labourers may e attributed to the excessive cost of building, ue to:—

(1) The increase in prices of labour and materials during the past twenty years, and

(2) Restrictions of local authorities, contained in building by-laws.

Evidence of the excessive cost of building may be gathered from various sources. Mr. Rider Haggard, speaking on "Rural Housing" on the 11th May last, observed that a pair of cottages could not be built under £400, and would not pay at 1s. 6d. a week rent. In a paper on "Cottages for Agricultural Labourers,"* Mr. Martin Shaw Briggs states that "good stone cottages with parlour, living room, and detached washhouse cost £350 to £400, and a good brick cottage is hardly ever less than £200." His estimate of the cost of a model design, having regard to agricultural requirements and capabilities, is for the cheapest type £300 in stone, £200 in brick, or £150 in concrete, the cottages being "the smallest that could be built at all, compatible with decency." Again, Mr. W. F. Ingram, in a recent address to the East Sussex Farmers' Club, points out that a double cottage costs £500. He shows the return on this outlay as follows:—

		£ s. d.
Rent per house, probably 2s. a week......		10 8 0
Less repairs, say £1 per house	£2 0 0	
Insurance	0 6 0	
Rates, rateable value £12 at 5s.	3 0 0	5 6 0
Leaving a nett return of		£5 2 0

Or a very little over £1 per cent. per annum.

The general increase in the prices of labour and materials, which to some extent accounts for the excessive cost of building, is shown by a report issued in October, 1903, by a Special Committee appointed by the City Corporation of Birmingham to investigate the conditions as to housing in that great Midland town. "Wages"—runs the report—"in the building trade have gone up from 20 to 30 per cent. during the last twenty years; materials have also risen considerably in price."

In addition to the increase in prices of labour and materials, the restrictions in by-laws made by local authorities, have, to no inconsiderable extent, contributed to the increased cost of the erection of cottages. The scope of those by-laws may be gathered from a brief reference to the enactments under which they are made. The power to make building by-laws is conferred upon local authorities by the Public Health Act, 1875 (38 and 39 Vict., c.

* *Journal of Sanitary Institute*, vol. xxiv., part 4, p. 548.

55). Section 157 empowers every urban authority to make by-laws with respect to the structure of walls, foundations, roofs, and chimneys, of new buildings, as to sufficiency of space and ventilation, and as to drainage. By Section 276 of the same Act, the Local Government Board may, on the application of the authority of any rural district, declare any provisions of this Act in force in urban districts, to be in force in such rural district or contributory place. Under this last section many rural authorities have adopted urban powers for the purpose of regulating the erection of new buildings in their districts. Such by-laws are generally based upon the model series issued by the Local Government Board, which prescribe structural details of a comprehensive nature, the general effect of which is materially to add to the expense of building.

It may with some reason be asked why, in the face of the cessation in building in rural areas, has it been found necessary for rural district councils to adopt building by-laws? It should therefore be explained that although there has been stagnation with regard to labourers' dwellings, other building operations continue in some country districts, the houses erected being either of a residential character or intended for artisans. And here it may be convenient to emphasise the distinction between the agricultural labourer and the artisan. The wages of the former are less than those earned by the latter, and his mode of living is lower. It may be taken that the agricultural labourer earns from 15s. to 18s. a week, out of which it is evident he cannot afford to pay a much higher rent than the figure given in Mr. Ingram's statement (see p. 411).

Existing Laws and their Administration.

In order to trace the effect of existing laws upon the question under consideration, a brief review of the principal Housing Acts may not be inappropriate. Those Acts comprise :—

Session and Chapter.	Title.
38 & 39 Vict. c. 55	The Public Health Act, 1875.
41 & 42 Vict. c. 25	The Public Health (Water) Act, 1878.
45 & 46 Vict. c. 50	Municipal Corporations Act, 1882.
48 & 49 Vict. c. 72	Housing of the Working Classes Act, 1885.
53 & 54 Vict. c. 16	Working Classes Dwelling Act, 1890.
53 & 54 Vict. c. 70	Housing of the Working Classes Act, 1890.
56 & 57 Vict. c. 33	Do. do. 1893.
57 & 58 Vict. c. 55	Do. do. 1894.
59 & 60 Vict. c. 11	Do. (Ireland) 1896.
59 & 60 Vict. c. 31	Housing of the Working Classes Act, 1890. Amendment (Scotland) Act, 1896.
63 & 64 Vict. c. 59	Housing of the Working Classes Act, 1900.
3 Edward vii. c. 39	Do. do. 1903.

The following are the main provisions of the above Acts affecting rural authorities :—

The Public Health Act, 1875, is the chief enactment under which sanitary authorities exercise administrative powers. The Act generally provides for the sanitary requirements of urban and rural district, and, *inter alia*, confers upon local authorities power to make by-laws as to new buildings.

The Public Health (*Water*) *Act*, 1878, (Section 3), enacts that every rural district council must see that every house within their district has within a reasonable distance an available supply of wholesome water, and also (Section 6) makes it unlawful for any new house to be occupied, under a penalty not exceeding ten pounds, unless and until the owner has obtained from the sanitary authority a certificate that there is provided such a supply.

The Housing of the Working Classes Act, 1885, confers certain powers upon sanitary authorities with regard to tents, vans, sheds, or similar structures used for human habitation, with the view of promoting cleanliness therein, and preventing the spread of infectious diseases.

The Housing of the Working Classes Act, 1890, is a consolidating Act. Part II. affects rural areas, and empowers sanitary authorities, in the case of buildings unfit for human habitation, to take proceedings against the owner or occupier for closing the dwelling house, or if not rendered fit for human habitation, to order the demolition thereof. Power is also given to local authorities to deal with obstructive buildings, and in certain cases to direct a scheme to be prepared for reconstruction. Part III. deals with the establishment of working-class lodging houses.

Of the Acts amending the Act of 1890, the

63 and 64 Vict. c. 59, and the 3 Edward VII. c. 39 are the most important. The former amends the procedure by which a council of any rural district, with the consent of the County Council, may adopt Part III. of the Act of 1890. The latter contains important modifications of the principal Act (*i.e.* the Act of 1890), including the extension of time for repayment of loans to a maximum period of 80 years, and the withdrawal, for purposes of the Housing Acts, of the limit of borrowing powers contained in Section 234 (2) (3) of the Public Health Act, 1875.

From this brief review it would appear that the Housing Acts place upon local authorities onerous duties with regard to the housing of the working classes, and entrust them with powers of far reaching effect. Nevertheless, it has been felt that in some instances the provisions of the Acts are inadequate to attain the object for which they were promoted. For instance, in the Public Health (Water) Act, 1878, the limitation as to expenditure for obtaining a supply of water, enables an unwilling owner to evade its provisions. A calculation shows that £8 3s. 4d. per house, or £13 after appeal to the Local Government Board, are the maximum sums which local authorities can call upon an owner to spend in finding a sufficient supply of wholesome water in rural districts, whereas, in actual practice, those amounts are usually found to be insufficient. It is also regrettable that the Act contains no provision with regard to the proper construction of a well.

The Housing of the Working Classes Act, 1890, the most important of the Housing Acts, has been criticised freely on account of many technical difficulties found in the course of its administration. It is unnecessary to enter upon a detailed criticism herein, and it will be sufficient to observe that modifications of this Act are required in the direction of simplifying some of the legal processes incident to giving effect to its enactments.

It comes more within the purpose of this paper to examine the actual effects of the working of these Acts, and to observe whether their administration tends to mitigate or to augment the social and financial difficulties alluded to. To facilitate such an investigation, a statement has been prepared (Appendix, pp. 416-7) giving particulars of actions taken by a rural sanitary authority in some typical cases under the Housing Acts.

It will be observed, from the Appendix, that properties condemned as unfit for human habitation in some instances become mere channels of speculation. New premises, constructed to replace them, are intended for other purposes than labourers' dwellings. Take, for example, case No. 3. Here the proceedings of the local authority resulted in the displacement of 12 to 15 persons. No provision was made for their replacement, and the condemned houses were sold and converted into business premises. Thus an Act, intended for the better housing of the poor, becomes both an instrument by which the labouring classes are displaced, and a useful lever for speculative purposes. In case No. 4, a dilapidated house was bought up, and converted into a model country residence, and in case No. 7, a cottage was demolished, and the site offered for building purposes at enhanced value.

It will be apparent that the effect of such transactions is to set the Act at nought, and it would appear advisable that steps should be taken to secure such an amendment of the law as will, in the closing or demolition of cottages, secure suitable accommodation for the tenants displaced. This principle has been recognised in other cases. The Standing Orders of Parliament require, in any case where it is proposed by a Bill to authorise the taking, in any urban or rural district, of ten or more houses occupied by persons belonging to the labouring classes, there shall be deposited with the Local Government Board a statement* of the number, description, and situation of such houses, and the number of the persons residing in them.

It is the rule of the Local Government Board to arrange for the holding of the local inquiries in connection with these applications in the evening of the day appointed, so that occupants of the houses in question may have an opportunity of being present, and due intimation of the inquiry is given by the service at each house of printed notices setting forth the nature of the application.

A Joint Committee of both Houses recommended in 1902 that provisions on the subject should be embodied in a general Act of Parliament, and this has been done in Section 3

* From thirty-four such statements deposited with the Local Government Board in 1902, it appeared that it was contemplated during the Session of 1903, by means of thirty-two Railway and other Bills and two Provisional Orders, to obtain powers to acquire in England and Wales, exclusive of London, 3,374 houses, the number of persons residing in such houses being 14,193. During the year, sixteen applications were dealt with of schemes for providing new dwellings in connection with displacement.—32nd Report of Local Government Board, p. clii.

of the Housing of the Working Classes Act, 1903, whilst others of the Housing Acts stipulate for the provision of dwelling accommodation for persons displaced under schemes.

Those acts do not, however, provide for the rehousing of occupants displaced by proceedings for a closing order and demolition under Section 32 of the Act of 1890. Sub-section 3 of that section provides that the local authority shall serve notice on every occupying tenant, and he and his family shall cease to inhabit the dwelling house, and in default shall be liable to a penalty not exceeding twenty shillings a day. The only recompense the local authority is authorised to make is a reasonable allowance on account of expenses in removing. Cogent reasons could be urged against setting the precedent of making local authorities responsible for re-housing in all cases when sanitary notices lead to displacement. At the same time, abundant evidence could be adduced to prove that there are many cases in which genuine discomfort and loss are suffered by occupants who are undeserving of such punishment, and in this matter it would seem requisite in any amendment of the law, to give some measure of discretionary power to local authorities.

Another matter, upon which displacement has some bearing, is the procedure which follows the service upon owners of notices other than those which actually call for the removal of tenants. In such cases an owner, of his own accord, may tender notice to his tenant to quit the premises, and there are doubtless many instances of careless occupiers bringing about insanitary surroundings through their neglect, which warrant such an act on the part of an owner. It is not a specific duty of sanitary authorities to follow occupiers who have thus been displaced, but it is tacitly understood in the present state of rural housing, that the only course open to the tenants is to move to some remote spot, where they may find houses similar to those vacated, and where to get any shelter they are perforce compelled to huddle together with others. The inevitable result is overcrowding, and the dreary repetition of proceedings. Reference may be made to Case No. 9 (Appendix pp. 416-7). The occupiers were traced to four different houses, and there is some likelihood of their coming under the notice of the sanitary authorities for the fifth time.

Insufficiency of cottage accommodation contributes to over-crowding, and the large families prevalent in some villages accentuate this nuisance. Instances could be cited of occupants who have tenanted their houses from early marriage till old age, and who have become as much a part and parcel of the estate as the house in which they live. They have brought up large families in the same house, and though overcrowding existed as the family increased, no stigma could be attached to them for want of respectability. Yet their mode of living is against the principles of health, and is, moreover, a direct contravention of the Public Health Act, 1875 (Section 91 (5)) wherein overcrowding is deemed a nuisance when dangerous or injurious to health. The importance attached by the Legislature to the abatement of overcrowding is indicated by this sub-section being the only part of the Act in which an offence is made punishable even when *dangerous* to health, apart from actual injury having been caused.

Further, with regard to overcrowding, it is paradoxical that sanitary measures sometimes increase the nuisance. Mention has already been made of persons displaced from insanitary houses being compelled to crowd with others. An illustration of another type is that of an owner, who, in order to improve the sanitary state of his dilapidated houses, converted each couple into one, with the result that in a small area the number of dwellings was reduced by ten! Needless to say overcrowding resulted. Although overcrowding may not always have had mischievous effects, there are, unfortunately, cases which plainly indicate that this state of living has sometimes been a predominant factor in bringing about cases of incestuousness.

Mention has been made that the Housing of the Working Classes Act, 1885, gives some control to local authorities over dwellers in tents, vans, sheds, and similar structures. Case No. 12 (Appendix pp. 416-7) has reference to proceedings taken with regard to an encampment of tents and vans. It is a feature of country housing, that, in addition to the dwellers in tents and vans, there is a never ending stream of nomads, who do not come under the operation of sanitary laws, and the Council of the Sanitary Institute have forwarded to the Local Government Board a copy of a resolution passed at the Bradford Congress, requesting the Government to "take into consideration the necessity for legislation to deal more effectively with those resorting to common lodging houses and workhouse tramp wards as a constant and dangerous element in the propagation and dissemination of small-pox."

An indication of the extent to which the ousing of the Working Classes Act, 1890, is lministered in rural districts is furnished by e following excerpt from the Local Govern-ent Board's report for 1902-1903 :—

ımber of Rural District Councils who proceeded under the Act	130
ɔtal population of the area comprised in the districts of those authorities	1,662,714
ımber of houses as to which representations were made during the year......	1,645
ımber of houses in respect of which the local authorities decided not to take action	9
ımber of houses made fit, or being made fit for human habitation, without closing orders having to be obtained	1,318
ımber of houses in respect of which closing orders were made by Justices during the year	78
ımber of houses ordered to be demolished by the local authorities	6

The same report shows that, in the year ending st December, 1902, one rural district council ceived, by way of loan, the sum of £1,850 ıder the Housing of the Working Classes ct, 1890. In the same period, Town Councils ıd Urban District Councils received the sum £337,560. In the twenty years ending 02, the Local Government Board sanctioned ıns for housing purposes, in urban and rural stricts, amounting in the aggregate to 3,027,300.

From what has been said, it appears that e dearth of labourers' dwellings is at the root many unfortunate circumstances in country stricts. To mitigate the evils mentioned, it necessary that cottage building should be aced upon such a basis, that the low rents ıyable by the agricultural labourer may leave moderate margin upon the outlay of capital. effect such a change, the cost of building ust be reduced, and the first step in this rection would be to dispense with any re-ictions in by-laws, which may be removed thout endangering the health of the public. nis step has already been taken in some aces, as the Local Government Board now sue a revised series of building by-laws ited to rural districts.

Another important matter, bearing upon the strictions in by-laws, arose in a recent case at came before the High Court* a short time go. In 1877 the Local Government Board decided not to agree to give local authorities a power of discretion, enabling them to dispense with the stringent rules of the series of by-laws, in cases in which they were deemed not to be applicable. In the case in question the Judges dissented from the practice of the Local Government Board. It appeared that a by-law made in the model form, requiring every person who erects a new building to cause it to be enclosed with walls of brick, stone, &c., is a good and valid by-law, even though made for an area of rural character. But that if proceedings are taken for a breach of the by-law in such a case, it is competent for the Justices to treat non-compliance with it as a trifling offence within the meaning of Section 16 of the Summary Jurisdiction Act, 1879, and to dismiss the information accordingly. Mr. Justice Channell said, "It seems to me that all by-laws relating to construction of buildings should contain something in the nature of a dispensing power, enabling . . . somebody to say that a building is of an exceptional character, and that the . . . by-laws ought not to apply." That is quite a revolution in the orthodox way of dealing with by-laws.

In addition to the modification of by-laws, some financial measures would probably be essential before the erection of labourers' cottages could be carried on, so as to give a moderate return upon capital expenditure. The following table shows the amount of loans sanctioned by the Local Government Board during the year 1902, under the Housing Act of 1890, in town and rural areas, and the rateable value of the respective areas :—

Authorities.	Amount of Loans.	Rateable Values.
Town Councils and Urban District Councils......	£337,560 ..	£98,344,591
Rural District Councils .	1,850 ..	52,084,348

Calculating from the above it appears that, taking an equal rateable value in town and rural districts, the ratio of borrowing is 103 : 1. The metropolitan area has not been included, otherwise the disparity would be greater. In 1902, town areas borrowed on housing more than three hundred times the amount borrowed by rural areas, whereas the rateable value of town areas is barely twice that of rural districts.

The limits of this paper do not permit a detailed consideration of the relative financial positions of urban and rural districts, but as an incentive to discussion it may be remarked

* Salt v. Hall. Knight's "Local Government Reports." tober, 1903.

STATEMENT SHOWING RESU

WITH REGARD TO CERTAIN PROPERTIES CERTIFIED A

No.	PROPERTIES REFERRED TO:— Description.	Chief Sanitary Defects.
1	Six four-roomed cottages	Property generally in dilapidated state. I drainage. Two cottages defective walls, tumbling to decay. One case o ing, twelve in house. Worst houses by paupers in receipt of out-door relief.
2	Cottage and premises	Drainage defective and house overcrowd mises occupied by owner.
3	Three cottages and premises	Dilapidated condition. Roof in sever defective. No drainage. One cotta crowded.
4	Two tenement dwelling-houses	Very bad state of repair. Roof in seve falling in. Drainage defective and othe arrangements bad. Rooms overcrow house in unclean state. Attention of the National Society for Prevention o to Children had also been directed here.
5	Cottage and premises	Not weather proof. Defects in roof, w floors. Walls foul and house dirty. occupied by present tenant many years.
6	Two-roomed cottage and premises	Walls, floors, ceilings, and roof defecti small rooms occupied by husband, four children.
7	Two-roomed cottage and premises	In bad sanitary state generally and grea crowded.
8	Four-roomed cottage and premises	Very damp. Thatched roof. Family c consumptive; three or four deaths.
9	Cottage of two rooms, stone built	One-storeyed cottage in dilapidated condi
10	Four cottages and premises	No drainage, yards unpaved, floors, walls defective. Two houses overcrowded, adults of both sexes and of same famil ing one bedroom.
11	Cottage, two living rooms and scullery	Drainage wanting. Walls foul and pr dirty state. Separate rooms occupied couple, not married, both in receipt of relief.
12	Tents and vans, encampment of	A number of tents and vans in dirty co inspection. The site on which they pi been used some years. Soil had bec pregnated with filthy matters. No priv modation, and water supply unsatisfact

[...]DINGS TAKEN BY A RURAL DISTRICT COUNCIL
[...]AN HABITATION (53 & 54 VICT. C. 70, S. 32.)

RESULTS OF PROCEEDINGS :—

Effect upon Property.	Effect upon Occupiers.
Property made fit for habitation and put into thorough repair.	Nuisance of overcrowding abated. Occupiers moved into more commodious premises. Paupers were removed to workhouse.
Property repaired in accordance with notice served, by new owners, as old owner sold immediately on receipt of notice.	Owner, being also occupier, sold property and moved away.
Sold after notice served. New owners pulled houses down, and erected new business premises on site. Great improvement to district.	After various visits cleanliness in house improved, and overcrowding abated. Tenants displaced by erection of new premises.
Property changed hands after service of notice. New owner reconstructed premises into residential villa, thus improving the neighbourhood.	Great difficulty experienced by occupiers in getting other houses. Landlords refused to take them as tenants, having heard of action of sanitary authorities. Eventually found places, but have not been traced.
Notice served resulted in owner obtaining ejectment warrant, as tenant would not move. Roof finally taken off, and house pulled down.	Removed to another part of district.
House made habitable, and re-tenanted by young married couple.	Removed, but great difficulty in getting another house.
House demolished by owner. Site to be sold for building, being well situate for such a purpose.	Found house in another district, after many unsuccessful attempts.
Owner decided to close cottage. Now stands uninhabited, and falling into decay.	Removed. Had occupied the cottage in question many years.
Owner decided to close house. Now stands empty.	Occupiers had twice previously come under notice of sanitary authorities, first when occupying a tent found to be in an insanitary state, then for causing overcrowding in another house in which they were lodging. Upon present notice being served they moved out. Complaints again made as to the state of their fourth tenement, and in consequence they left. Has just been reported that they are now occupying an insanitary dwelling.
Owner decided to close houses.	Occupiers found difficulty in getting new houses. In two cases moved into houses in another part of district which had just been made habitable, under an order from the District Council. In third case woman and large family taken to workhouse.
Owner requested occupiers to leave, and premises were afterwards put into sanitary state.	Friends found shelter for occupiers, who will probably go into workhouse eventually.
Notice served on occupiers to cleanse, in compliance with By-laws. Owner requested to remove polluted soil, excavate, and make good concrete floor over whole site, to erect privies, and supply water. Work carried out satisfactorily, and improvement effected.	Occupiers of vans and tents generally move away after inspection and before service of any expected notice, returning again in few months.

that as may be shown by computation,* if loans for housing purposes were advanced in rural districts at a low rate of interest, a fractional increase only would be necessary in populous areas, in order to maintain the mean rate of interest on loans over the whole country. An increase of $\frac{2}{5}$ per cent. in towns would allow of a decrease of 1 per cent. in rural areas, or an average rate of 3 per cent. would be maintained by charging 2 per cent. in rural districts and $3\frac{2}{5}$ per cent. in towns, assuming, as would be practically certain, that rural areas would not borrow more than an amount proportionate to their rateable values. Taking the year 1902 upon this basis, a sum of £150,000 would have been available in rural areas. With such a sum, borrowed at a low rate of interest, it is reasonable to expect that some improvement would be effected in the distressful state of rural housing.

It appears that under the Housing of the Working Classes Act, 1890, loans have been made to private owners to the extent of a moiety of the capital expended, a case in point being a loan of £5,500 at $3\frac{1}{8}$ per cent. for the erection of houses in a mining town. It may be of interest to estimate the effect of such a transaction under the suggested terms in rural districts. Taking Mr. Martin Shaw Briggs's statement that a concrete cottage can be erected at £150, it may be assumed that if the proposed economies were effected, cottages could be built at about that figure. The following is an estimate of the return upon ten cottages, rented at 2s. 6d. per week, a moiety of capital being borrowed at interest at 2 per cent. per annum :—

	Per annum.
Rent (10 cottages at 2s. 6d. per week)....	£65
Less rates, taxes, repairs, and insurance, say, £2 10s. per cottage	£25
Nett rental ..	£40
Capital Expenditure :	
10 Cottages at £150........£1,500	
Moiety raised at 2 per cent. .. £750 Int.	£15
Leaving for liquidation of Loan ..	£25

If the balance were appropriated for repayment, the loan would be liquidated in thirty years. This makes no allowance for any return on owner's capital (£750), and even if repayment were extended over sixty years the return on capital would be barely 2 per cent. In the

* Rateable values in 1902-03 were :— Metropolis, £40 677,589 ; urban areas, £98,344,591 ; rural areas, £52 084 348 ; ratio of urban and metropolitan areas to rural areas is (nearly) 5 : 2. Hence (5 × 3·4 per cent.) + (2 × 2 per cent.) = 21 and 7 × 3 per cent = 21.

Housing Act of 1903, the maximum term repayment has been extended to eighty yea but there are many classes of buildings up which it would be unsafe to grant long o standing loans. The small profit shown figures, even with the advantage of borrowi at an exceptionally low rate, is a striki example of the financial difficulties connect with this question.

The rural housing question emphasises t need of country areas being placed under efficient sanitary administration as towns. late years matters have been improved in tl direction, and to secure further improveme some effort has been made to obtain secur in tenure of office for medical officers and i spectors, whose duties require them sometim to act in an independent spirit. Another matt that needs be mentioned is the desirability children being taught, at school, and in th homes, to look upon sanitation from a differe point of view than is often the case. Th contempt for the subject leads in later life the carelessness typical of insanitary su roundings. This is more noticeable in count than in town children.

The conclusions arrived at from this impe fect survey of an intricate question may summarised thus :—

(*a*) That stagnation in the erection labourers' dwellings characterises rural area

(*b*) That the consequent dearth of hous prejudicially affects sanitary administratio particularly with reference to the Housi Acts.

(*c*) That amendments are required in t Housing Acts.

(*d*) That to mitigate existing evils it necessary to take steps to encourage the ere tion of cheap cottages in rural districts f agricultural labourers.

(*e*) That initial steps in this direction m be taken by some modification of building b laws, so far as is consistent with public healt

(*f*) That it is expedient to hold an enqui upon this subject generally, with the view promoting legislation thereon.

Finally, it may be of interest to observ that apart from financial affairs, there a many circumstances tending to prove th populous districts benefit at the expense country areas. The history of the housi movement is an example. Following up agricultural depression, came, first, negle of the farm homestead, then migration populous centres, with the consequent d pletion and ruin of villages. The housir

ovement arose from the congested state towns, and resulted in legislative easures that were primarily promoted in ie interest of town areas, though made pplicable in some respects to rural as well as ban districts. Even in its most modern iase the housing question makes country eas subservient to the needs of townships, r the proposal to remove the dwellings of vercrowded workers in cities to villages, culiinating now-a-days in the Garden City iovement, is in effect another claim of the nportunate towns for the purer atmosphere id healthier environments which are the atural heritage of rural places.

Happily, both town and country have comiunity of interest in maintaining the national haracteristics of a sturdy race. It is therere to the interest of all to preserve healthy onditions of living among the labouring lasses, whether the toilers be found amid the hud and throb of busy workshops, or among ie serene surroundings of English rural life.

[The author acknowledges with thanks the inrmation kindly supplied by Major Thornton, J.P., hairman, Sanitary Committee, East Sussex County ouncil, and by other members of the Uckfield Rural istrict Council. He would also mention the facilities obtain official information granted by Dr. Hugh tott, M.O.H., combined sanitary districts of East ussex, and Mr. J. Meredyth Evans, of the Sussex udit district, Brighton.]

DISCUSSION.

The CHAIRMAN said he had been interested in the uestion of the housing of the poor in a small urban istrict rather than actually in the country; but cotiges that were suitable for miners and people of that lass to live in would be equally suitable for labourers. he only consideration was the amount of rent which n agricultural labourer was able to pay, namely, from s. 6d. to 2s., whereas a man employed in an iron or oal works would be able to pay 4s., 5s., and more a eek. Therefore the difficulty was not so great from n economic point of view. He had seen a good iany cottages built which came quite up to the tandard that Mr. Martin Shaw Briggs suggested in he paper, who estimated that cottages with a arlour, living-room, and a detached washhouse, ould be built at a cost of £350 to £400. No mention as made of bedrooms, and he thought that £350 or 400 was a great deal of money to pay for such a ottage. He would like to ask the author whether he bedrooms were so well understood that they were ot mentioned. He saw some very well-constructed ottages built in blocks last year, at a cost of exactly £150 each, which contained a living-room and a kitchen, both of which were used for sleeping, together with a scullery and a detached washhouse. The author had shown that it was impossible, even with the repayment of an advance in 80 years, to build cottages at £150 apiece which would pay more than 2 per cent., owing to the very small rent which the agricultural labourer was able to pay. That brought one to an *impass*. He had never yet been able to solve the problem how labourers' cottages could be built otherwise than as as a form of charity, or for the general benefit of the estate. He quite understood that for the general benefit of an estate the proprietor might lay out money, for which he obtained no direct advantage, although a corresponding advantage was obtained in another way. If anybody could show how it could be done as a profitable investment, he would be very glad to hear it.

Sir EDMUND VERNEY, Bart., said there were many points on which he agreed with the author, but he looked at them with a different eye. There was an implication in the paper that some responsibility rested upon the owner of the cottages. He was the owner of a great many cottages, and he declined to accept any responsibility for them at all. He regarded them as a matter of business entirely. He would not accept responsibility for their sanitary condition, or anything else. Bodies were now elected whose duties it was to do such things, and if the landlord did it for them, they were only too glad to be relieved. The experience he had gained since he had been in possession of his estate, entirely confirmed that view. Quite lately the district council pointed out to him that some of his cottages had a bad water supply, but he replied that it was part of the duties of the district council to provide a proper water supply; it was no business of the landlord. He did not like to see councils shirking their responsibilities. The question of building new cottages and cottage-rents went very much together. The Chairman very truly said, that some landlords let their cottages at a rent which was really a charity. He did not; he refused to let them as a charity; he insisted on the payment of the full value, and he got it. The reason why people did not build new cottages, was because landlords, who were called good landlords, let cottages at far below their value. He took every opportunity of putting his cottage rents up, with the result that local men found it paid them to build cottages at their own expense, because they got a return for their investment. The author had referred to cottages being built with borrowed money repayable in eighty years. If there was a scandal against which he protested more than another, it was the lending of money on long terms of repayment. Any building erected eighty years ago would now be considered absolutely out-of-date. Each generation should pay its own bills; and he thought twenty-five or thirty years was the very longest term for which

the money should be lent for any purposes of permanent improvement. The law laid upon the district councils the definite duty of not permitting houses to be inhabited that were unfit for human habitation; they had no responsibility for re-housing them at all. At the present moment the slums of New York were being cleared by putting the law in force, and not allowing people to inhabit houses that were not fit for habitation. The person whose duty it was to do that was the medical officer of health, who, in the district he belonged to, in Buckinghamshire, was dismissed because he did his duty, and made it hot for the people who owned insanitary houses. Many medical officers of health obtained their living as the medical attendants of farmers and members of the district council, and could not afford to oppose such men, and therefore dared not do their duty. Miss Constance Cochrane, in an extremely valuable paper, quoted Mr. Long's reply to a deputation in the following words: "The proposal that the medical officers of health's hands should be strengthened was one which he had great sympathy with, but the medical officer of health was the servant of the local authority, with the members of which he had often to find fault, and therefore if he were to do his work successfully his position would be extremely difficult, not to say invidious." Why did not the Local Government Board take steps to remedy such a condition of affairs? Sympathy did not go far; action should be taken. There were three ways in which the question could be dealt with. In the first place, the medical officer of health should be appointed by, and be responsible to, the Local Government Board, so that rural district councils could not supersede him. In the second place, there should be a sanitary committee for the whole county, with one medical officer of health, under the sanitary committee, doing nothing else, and responsible only to them, with a number of subordinate medical officers of health all over the county. That was tried in Buckinghamshire. The county council appointed a sanitary committee, which drew up a report, in which they pointed out the insanitary condition of the county, and recommended that a medical officer of health should be appointed for the whole county. When the county council received the report they abolished the committee! Among his suggestions at the end of the paper the author stated that in order to mitigate existing evils he thought it was necessary to take steps to encourage the erection of cheap cottages in rural districts for agricultural labourers. He (Sir Edmund) advised that the rents should be raised, and then cottages would be erected; the labourers would say to the farmers that owing to the high rent they must have more wages, and they would get it. The author further thought it was expedient to hold an inquiry upon the subject generally with the view of promoting legislation thereon. If the author would alter the suggestion to the effect that an inquiry should be held with the view of seeing whether legislation was required he would quite agree with it. His opinion was that the present l[aw], if it was carried out, was quite strong enough.

Miss Constance Cochrane thought the pri[n]ciple Sir Edmund Verney had referred to was a g[ood] one, but it was difficult in poor counties, such as [the] corn lands of Cambridgeshire, to get as high a r[ent] as £12 a year. The customary rent of £3 10s. w[as] less than ought to be paid; even as they were p[aid] at present she thought the labourers could aff[ord] £5 a year. One suggestion by which cottages might [be] made to pay was that if from one to three acres of la[nd] were added to the cottages a much higher rent mig[ht] be charged. It would take the place of allotme[nts] which, perhaps, were a mile or two away with [no] sheds on them, and the whole of the family cou[ld] cultivate land in their spare time. She advocat[ed] that Part 3 of the Housing Act should be carri[ed] out. There seemed to be a feeling amongst ru[ral] authorities that if they could not build for the ve[ry] poor they should not build at all, but it was necessa[ry] that the number of cottages should be increased, a[nd] if three or four cottages were built and let at com[mercial] mercial rents, so that there would be no charge o[n] the rates, there would be that number of cottag[es] more in the village. When she heard the remar[k] made over and over again that the people should b[e] induced to stay in the country, she always replie[d] "Give them houses to live in first," because sh[e] knew as a fact that a number of people were force[d] out of the country because there was no room f[or] them, and everyone that went drew another aft[er] him. The standard of living was higher than it use[d] to be, and the people could not bear the style o[f] cottage, which was the only one available in man[y] instances. It was easier to get a corner in a tow[n] than it was in the country at the present moment. With regard to the water supply, Mr. Long ha[d] promised a deputation a few weeks ago to em[body] body some new regulations in the new Act. I[n] many villages there had been absolutely no whole[some] some water at all. The association with whic[h] she was connected sent out a circular lette[r] to a great many rural sanitary authorities, an[d] answers had been received from sixty of th[e] clerks, stating that they were unable to do thei[r] duties in regard to the abatement of overcrowding and the condemnation of houses unfit to live i[n] because of the great scarcity of houses; and they had not the heart to turn the people into the streets. While there was undoubtedly a desire on the part of some rural district councils to do their best, and make things better for the people, at the same time she was afraid that a great many shirked their duties. What would be said if factories were inspected by inspectors appointed by the factory owners? It was a common thing for those who obtained office as rural sanitary authorities to do so in many instances, with the purpose of guarding their village slum interests, and to prevent anything being done. It had been remarked to her that the only medical

ers of health who had security of tenure at the ent moment were the bad ones. Mr. Wilson , of the Board of Trade, in a paper which he before the Royal Statistical Society last spring, ed that until the inspection was performed by nterested persons, appointed, either by the Local ernment Board or the County Council, who had nterest at all in the locality, so long would the litions of labourers' cottages remove a blot on lish civilisation.

[iss CHURTON read several replies which had received from various rural district councils in ver to the circular letter referred to by Miss hrane. The council of St. Faith's, Norfolk, ed that some houses in a village were so con- cted and placed that sanitary conditions were ossible; they should have been condemned unfit for habitation, but the council were by the difficulty that to condemn them would only ease the existing overcrowding. The council of don, Essex, said they had long felt the want of able cottages within their districts, and that per cottages must be forthcoming or the process lepopulation would continue. In Devonshire the lical officer reported that a very large proportion ottages had no fire-place in a bedroom, and often one fire-place in the whole of the house, so that as most difficult to deal with cases of sickness. y also were so dilapidated as to be unfit for an habitation, but rents were so low that owners nd did not care to build cottages.

r. J. L. GREEN stated that he had visited nearly thousand parishes in England, and could bear many of the remarks which had been made as to present deplorable condition of things. He very much surprised at Sir Edmund Verney's rvations in regard to raising the rent. That ht be an economic solution of the difficulty, but he d not get away from the idea that the landlords some responsibility in the matter. He did not k the local authorities were the proper people to e the question of housing in rural districts, be- e if local authorities put up cottage property it impossible for the labourers to pay the rents ged, inasmuch as the cottages could not be t under £150 or £200 per cottage. If the labourer a good cottage he ought to pay a fair rent for it, it was impossible for him to do so with the pre- wages he received. He wished to inquire of what od cottage consisted. He would like to see a age with a parlour, a back room, a scullery, the ssary out-houses, and three bedrooms at least, a fire in two of them if possible, in addition one in the front and back rooms downstairs. did not see why a landlord should not pro- as good cottages for his labourers as he vided pig-pens and cow-stalls for his cattle. If bourer had to pay a commercial rent for a cot- , which would be 4s. or 5s. a week, then the landlord might do his share towards assisting the labourer to pay that rent. The labourer now-a-days had been led to expect everything for nothing, but if he were given a good cottage, and made to pay his own rates and taxes, he would become a better citizen. He had found that cottages on large estates were invariably well kept, and that the worst cottages in the country were owned by the speculating builder and the small tradesman, who, perhaps had had a cottage left to him by his father, and let it out at the highest rent, irrespective of its condition. If they could not rely on the good sense of the landlord to keep the property in repair, an obligation should be imposed on him compelling him to do so. It was not sufficient to rely on the local sanitary authorities; the Local Government Board should control the medical officers of health, who should be independent men, so that the necessary pressure could be put on the owners of small property. With regard to the author's remarks about the model by-laws, the by-laws of to-day were, in his opinion, practically sufficient for cottage property in rural districts.

Lieut.-Colonel ALLAN CUNNINGHAM thought that, however deplorable the over-crowding and insanitary conditions were in the country, they were not so bad as those existing in towns. Good cottages could not be built to yield more than 1 per cent. interest, or, if the repayments were deferred 80 years, 2 per cent. If that was the case, the building had to be done as a charity, which could not be expected, because the work must be done on economic principles if it was done at all. The great difficulty lay in the fact that England was a small country, and was over-populated. Seven million people were said to be always on the verge of starvation, of whom a considerable number must live in the country. Sir Edmund Verney spoke of a better class of tenant, and probably more limited in number than those referred to by the author. The two lady speakers had referred to the advantages of good sanitation; but whatever steps were taken, great care should be exercised, otherwise the building of cottages would be made more expensive still, and the difficulties of the housing problem would thus be increased.

Mr. SEYMOUR WILLIAMS said that Sir Edmund Verney had referred to the question of the length of the term of the loans. Two years ago a Departmental Committee sat on the subject, and evidence was given before the committee in favour of extending the time during which loans for the purpose of housing operations were granted. Sir Edmund also complained of placing a burden on the next generation, but it must be remembered that part of the security for the loan was the land itself, and therefore the objection was not valid on that point. So far as the erection of the buildings was concerned, he thought Sir Edmund was hardly fair in saying that the building would be of no value in eighty

years time. Repairs from time to time would be made to the building, which would keep it in good condition; but it was useless to expect local authorities to take up loans if there was any serious risk involving a large rate. There was no doubt a certain amount of truth in the statement that some rural district councils did not do their duty, but he repelled the suggestion that all local district councils were lacking in their duty. Conditions varied very much in different parts of the country. In the West of England very little was heard of the rural housing question; there was no dearth of houses in his district at the reasonable rent which labourers could pay, so that in any legislation a hard and fast rule must not be made. The housing question affected the well-being of the country as a whole, because the exodus from the country into the towns was largely due to the greater comfort people found in living in the towns; and he therefore thought that a consideration of the subject, with the view to seeing whether fresh legislation was needed, was desirable.

The CHAIRMAN asked the author if he could explain the curious anomaly that, notwithstanding so much of the agricultural population had gone into the towns, the housing accommodation in the country was so small in proportion to what was required.

Mr. BRICE PHILLIPS said, in reply to the Chairman's inquiry as to the number of rooms in the cottages for which estimates had been given, that it would be seen, by a reference in the paper, that the figures were taken from Mr. Briggs' article in the Journal of the Sanitary Institute. That article gave full particulars, together with detailed plans, and the speaker recommended members desiring to obtain further information on those points to refer to that comprehensive paper. There were some points in which he agreed with Sir Edmund Verney, such for instance as obtaining security in office for medical officers. But he could scarcely follow Sir Edmund in saying that owners could repudiate all responsibility. He had endeavoured to show in his paper that the Legislature had already placed many responsibilities upon the shoulders of owners. Sir Edmund's statement that local authorities should take the duties upon themselves, would not meet the case, for, as a general rule, the work of local authorities consisted in enforcing owners and occupiers to carry out their legal responsibilities. He would be satisfied to accept the suggestions made by Sir Edmund Verney as to an inquiry. With reference to Miss Cochrane's proposal that district councils should build a few houses in each village, he feared the financial difficulties referred to in his paper would prevent this. From Mr. Green's remarks he gathered that he was also of that opinion. He could endorse what Mr. Green said about the better state generally of properties on large estates. It was the impecunious owners who gave trouble to sanitary authorities. As to the anomaly mentione[d by] the Chairman of rural depopulation going on sid[e by] side with overcrowding, he could only offer as an [ex]planation that more room was now required for [ea]ch person than formerly, arising perhaps to some ex[tent] from the increased luxury in the living of all cla[sses], and also possibly to more stringent sanitary requ[ire]ments.

On the motion of the CHAIRMAN, a hearty vot[e of] thanks was accorded to the author.

Miscellaneous.

MANUFACTURE OF PANAMA HATS.

The celebrated Panama hats are made in [the] Departments of Santander, Antioquia, Cauca, [and] Tolima (Suaza district), in Colombia. For the ma[nu]facture of these hats, the common fan shaped palm [is] used, known to the natives as the "palmicha." [It] grows wild, and in abundance. The young sho[ots] are chosen, uniformity in size being an import[ant] consideration. The British Vice-Consul at Bog[ota] states that the shoots after being cut from the bran[ch] are boiled for a certain time till they soften and tur[n] light yellow in colour. After boiling for the desi[red] length of time, the leaves are hung up to dry, a[nd] quickly separated. The work is carried on indoo[rs], where they are exposed to a current of air, but no su[n]. When the leaves are nearly dry, a little Y-shap[ed] wooden tool is used, which splits the leaves uniform[ly]. When they are drying, the leaves curl in at the edg[es] and are then ready for use. The straw is afterwa[rds] wrapped in clean cloths to protect it from t[he] light and dry atmosphere. The process of boili[ng] the straw is an art in itself. There are few workm[en] who succeed in turning out good straw. It is so[ld] by the pound, the price being fixed according to t[he] quality of the straw and the market price of hats. [In] the Suaza district of Colombia, the hats are ma[de] on solid wooden blocks. It takes two to four perso[ns] (usually women) seven days of steady work to ma[ke] an average quality hat. A fine hat will take fro[m] three to six weeks. When the hat is finished t[he] straw is carefully pared with a penknife, and th[en] battered all over with a small hand-mace. It is th[en] washed with common yellow soap and lime juic[e] and left to dry in the sun. The climate is an im[portant] consideration in the manufacture of the hats. A better hat can be made during the rai[ny] season than during the dry summer weather. This [is] probably why the hats made in the rainy Suaza di[s]trict are superior to those made only a few mil[es] away. A long training is required to become a goo[d] hat maker. Female children are usually apprentice[d] at about the age of 10, and are constantly kept a[t] work. Hat makers work steadily every day, fro[m] sunrise to sunset, and often continue their work b[y]

lle light, so as to have their hats ready by market An hour or two wasted means to them the of the market day, and consequently the loss of ly money for their household purchases. It is a good business to export Panama hats from ombia at the present day. The price in the Suaza rict has increased to an exorbitant extent. merly, the finest quality hat could be purchased e for 12s. This price has now more than doubled. ortunately, to reach the Suaza district means a g and tedious journey, and the purchaser is there- dependent on the middleman, who fixes his price a first quality hat on the basis that his article, if orted, would fetch £20 in London.

Correspondence.

HE REPRESSION OF THE BRITISH INVENTOR.

As a British inventor with more than twenty years' ctical experience of the British Patent-laws, l having taken out some thirty patents, I have been remely interested in the correspondence in your *urnal* on the above matter, and I heartily agree h the position taken by Mr. Lowry and Mr. Boult, t the present system prevailing in the British tent Office is iniquitous and unjust to the inventor, l has done more than almost any other one thing discourage English ingenuity and enterprise.

It is not my purpose to defend the German or ited States Patent-laws, which may be (and ıbtless are) open to the criticisms made by Mr. el. The fact that these countries have made mis- es in this line in no wise minimises the mistakes ich our country has doubtless made, and I there- e do not propose to enter into a discussion of . Abel's letter. What interests me as a British in- ıtor, are the facilities the British Patent Office affords for protecting and exploiting my inventions. My erience is, that it would be hard to devise a method ich is more unjust to the inventor than the one ich has prevailed in England for the last twenty- e years at the least.

The Act of 1902 has improved matters somewhat, t it does not get to the root of things, as it retains e very burdensome and unjust renewal fees which, ming as they usually do in the case of a new inven- n, just at the time when the inventor is least able meet them, cannot be met, and therefore the in- ntor loses his time and the moneys already paid.

As Mr. Boult very justly states in summing up his mirable letter: "Can anyone maintain that it is st that the patentee pays for his protection 1,188 nes as much per annum as the author?" This is hat the present Patent-law provides. To give you practical illustration in my own case, which is one many (and I may say that I have made so many luable inventions that I am now financially ruined, though many of my inventions are practical and commercial, and have made thousands and hundreds of thousands of pounds for others), I will instance one case, *i.e.*, the cinematograph.

I will not enter into the history of this invention except to say that I began working on it over twenty years ago, long before it could be possibly made commercial, for the reason that, at the time I began my experiments and for several years thereafter, celluloid was not made in long lengths, and therefore could not be used for cinematograph films.

I first showed my invention at a meeting of the Photographic Society, Pall-mall, in 1885. The invention itself was first patented in 1889. This patent gives a complete description of the cinematograph camera which is used to-day, but it was not then commercial, for the reason that celluloid film was difficult to secure, was expensive, and was too opaque to give proper results upon a screen. In fact it was not until 1893 or 1894 that a non-shrinkable celluloid photographic film transparent enough to enable pictures to be projected upon a screen was produced commercially.

I took out a further patent in 1893. This patent covered the projecting apparatus, and is the first machine of its kind. In 1896 I took out a further patent, covering certain improvements and attachments for this machine; and this patent, together with my patents of 1889 and 1893, are the master patents on this invention. I had expended thousands of pounds and ten years' time in perfecting this invention.

Directly my patents were published others profited by my work, and brought out various forms of machines, all of which I maintain are infringements of my patents; but I was not in position financially, owing to the large amount of money I had expended on this and other inventions, to properly protect my rights in the Courts, which would have cost me, as I was informed, from £2,000 to £5,000 at least.

The fact that I had obtained British patents on my invention did not in any way practically protect my rights as against infringers, who, knowing the practices prevailing in the Patent Office and in the Courts in reference to inventions, took the chances of a patent action, and exploited infringements of my invention for their own profit without payment of a penny to myself.

That is the condition to-day, with the exception of two firms in the trade who, as a matter of fairness to me (although I have not yet been in position to bring action to protect my rights) have entered into royalty arrangements, and are paying me royalties on my invention, although nothing like as large royalties as I should have been entitled to receive, and which they no doubt would have been prepared to pay, had the Patent-laws been so framed as to discourage infringers, rather than encourage them, as is the case to-day.

I do not say this as any reflection upon the two firms who are paying me royalties. Quite the contrary. They could afford to pay me much larger

royalties had the English Patent-laws been so framed as to enable me to protect them from unlawful competition. As a matter of fact these firms are to-day paying royalty, which the other firms are not, and are, to this extent, hampered in their business by reason of their recognition of my rights. In other words, the practical result is, that the infringer is protected by the present laws, whereas the inventor is in the position of paying the British Government for the privilege of giving the details of his invention to the very men who are encouraged to infringe it.

This has been my experience with my cinematograph invention, and also my experience with many other of my inventions, but space prevents my going further into details.

Now as to practical suggestions, I do not for a moment imagine that the framers of the Patent-laws have deliberately tried to draw them so as to favour the infringers and hamper the inventors. On the contrary, I assume that it is the desire of the Government to frame laws which will encourage and protect the honest inventor.

Without going into detail, my suggestions are briefly as follows:—

1. That a thorough search be made by the British Patent Office before the patent is granted.

2. That the cost of this search should be included in the initial fee.

3. That when a patent is once issued by the English Patent Office the presumption is not that it is bad, but that it is good, and that this presumption be one that the British Courts are instructed to recognise in any action for infringement.

4. That the penalty for infringement (where the infringement is clearly proved) be not merely an injunction against further infringement and the actual damages proved (which latter are almost impossible of proof in many cases), but should be substantial and exemplary damages which shall be sufficiently large to discourage others from attempting to infringe what they know to be a valid British patent. In other words, "make the punishment fit the crime" which is not the case under the present law. In fact, it not infrequently happens that an inventor may win his action for infringement and be ruined by the delay and expenses he has to incur over and above his damages and taxed costs.

5. Any man stating in his application that he is the original inventor, when it is proved he knows he is not, should be held to be guilty of perjury and should be prosecuted by the Public Prosecutor at the public expense.

6. Make one fee cover the entire cost of the invention for the full term. You can figure out for yourself what it means to maintain 25 or 30 British patents, many of which while they are the basis of very valuable inventions, may be premature, in that certain features of the invention are not yet perfected, or the trade not yet sufficiently advanced to appreciate its value.

7. The appointment of a Royal Commission consisting of practical men who shall take evidence [on] this whole subject and report their recommendatio[ns] to Parliament. I would respectfully suggest th[at] you call before said Commission some of the practic[al] inventors and mechanics who have been either d[is]couraged from patenting their invention, or if th[ey] have been foolish enough to patent it, have be[en] ruined by the expensive processes which are necessa[ry] in order to protect their rights. I think this Com[]mission would get some good, solid facts whi[ch] would be of the greatest value in formulating [a] law which will do substantial justice to the Engli[sh] inventor and encourage the industries of the countr[y].

In other words, I make a plea for justice a[nd] common sense in our Patent-laws. Make it not on[ly] possible for a rich inventor to protect himself, b[ut] encourage a poor inventor to patent his ideas with [a] certainty that he will obtain a proper return for a[ny] good invention he may make, and full protection [of] his rights without danger of being financially ruin[ed] by his own inventive genius and his attempt to co[n]tribute something to the welfare of his country.

W. FRIESE-GREENE.

Millbrook, Dovercourt,
March 8th, 1904.

Obituary.

ADMIRAL HENRY BOYS.—Admiral Boys, wh[o] had been a member of the Society of Arts sinc[e] 1885, died on the 16th inst., at his residence a[t] Blackheath, in his eighty-fourth year. The Admir[al] was the second son of Captain Edward Boys, R.N. and a member of a family which for several years ha[d] supplied officers to the navy. He joined the servic[e] in 1837, and as a midshipman in the *Edinburgh* wa[s] at the capture of Birut and the bombardment of Acr[e] in 1840, being wounded in the latter engagement. Among the appointments held by Admiral Boy[s] before his retirement in 1885 were those of Directo[r] of Naval Ordnance from 1876 to 1878, second i[n] command of the Channel Squadron from June of th[e] latter year till June, 1879, and as member of the Com[]mittee on Heavy Ordnance in 1879.

MEETINGS FOR THE ENSUING WEEK

MONDAY, MARCH 28...British Architects, 9, Conduit-street W. 8 p.m. Mr. C. Stanley Peach, "Electri[c] Generating Stations."
Actuaries, Staples Inn Hall, Holborn, 5 p.m.
Medical, 11, Chandos-street, W., 8½ p.m.

TUESDAY, MARCH 29...Central Chamber of Agriculture (a[t] the HOUSE OF THE SOCIETY OF ARTS), John-street Adelphi, W.C., 11 a.m.
Civil Engineers, 25, Great George-street, S.W. 8 p.m. 1. Mr. Leopold Halliday Savile, "Lowering the Sill of the Ramsden Dock, Barrow-in Furness." 2. Mr. Robert Henderson, "Burntisland Harbour: Construction of the East Dock."
Colonial Institution, Whitehall-rooms, Whitehall-place, S.W., 4½ p.m. Mr. E. Powys Cobb, "Federation and the Mercantile Marine."

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FRIDAY, APRIL 1, 1904.

communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

CIETY OF ARTS MAP OF THE WORLD.

map of the world has been prepared, wing the principal places outside the ited Kingdom, in which members reside, l to which the Society's *Journal* is sent. map has been produced by Messrs. rge Philip & Son, Ltd., and indicates the cipal steamship tracks, through lines of ways, principal naval and coaling stations, the distances between the chief ports of world. A copy of the map will be forded, post free, to any member who likes pply to the Society's advertisement agents, ssrs. Walter Judd, Ltd., 5, Queen Victoria et, London, E.C.

oceedings of the Society.

APPLIED ART SECTION.

uesday afternoon, March 15, 1904; Sir rge Birdwood, K.C.I.E., C.S.I., Vice-ident of the Society, in the chair.

he paper read was—

CENT DEVELOPMENTS IN DEVONSHIRE LACE-MAKING.

By Alan S. Cole, C.B.

is not possible, in the course of the paper about to read this afternoon upon recent elopments in Devonshire lace-making, to ete any time to an inquiry into the in and early growth of the industry. a considerable extent this has been done by the late Mrs. Bury Palliser, in her well-known work upon the history of lace-making generally.

The number of lace-makers in Devonshire is now probably far smaller than it was before machinery was invented to produce lace fabrics; and with this shrinkage in numbers of the workers there has been a corresponding shrinkage in the number of lace-making centres. The developments which we are to consider are those in respect of the lace-making aptitude, and in respect more particularly of the attention paid to the use of designs which are likely to prove beneficial, not only from a trade point of view, but also from the educational point of view. Now in trying to make clear what the recent developments have been in connection with the designs for lace, it has occurred to me that it will be well to indicate and illustrate certain typical stages in the progress of lace-making generally, and to notice as far as the few evidences allow, the Devonshire counterparts of these typical stages. Broadly speaking, development of texture in lace has accompanied development in its ornamental character, from the middle of the 16th century, when lace-making first became a recognised industry, down to the later years of the 18th century. During this period successive varieties of texture and ornament were evolved. Since then no evolution of distinctively new varieties has occurred. Machinery has largely imitated or made close adaptations from past historic styles; and up to within the last ten years, so far as the hand-makers of lace in Devonshire are concerned, there has been little effort to originate new styles of design.

I decided to speak of Devonshire lace-making in preference to Honiton lace-making: the latter seems to restrict one's survey although it is often the custom to give the name of Honiton to lace-making in different parts of Devonshire. But I do not feel sure that Honiton, however much it has been and is noted for its lace, has a prescriptive right to confer its name upon any particular phase of lace either as regards its texture or its ornamental effect. Moreover, the earliest records and references seem to indicate that lace-makers pursued their gentle art in several other villages, as, for instance, at Colyton, which, a few miles south of Honiton, was a lace-making centre as early as Honiton. Passing over this question of local precedence, it appears that the first lace made in Devonshire was called "bone lace." This, in tex-

ture and ornamental appearance was, I believe, similar to the insertions and dentated or vandyke edgings of tightly twisted and plaited threads, made into a sort of ornamental cord work, according to designs first published during the latter part of the 16th century in pattern books at Venice, and Paris, in Germany, and in Flanders. Besides the evidence as to style of ornament afforded by these pattern-books, other reliable testimony

FIG. 1.

PORTRAIT OF COUNTESS OF HAINAULT, BY MOREELZE, ABOUT 1600.

is furnished by contemporary portraits and monuments.

This comparatively stiff, almost wiry, cord work was invariably of geometric design. It was the predominant and only style for a time. Laces of softer, pliant, and delicate texture in which floral forms were the motives, laces with fine net grounds, and with all sorts of fanciful enrichments, were things of much later date.

During the first half of the 17th century the cord-like and wiry-looking laces were succeeded by those in which the ornament was rend in a texture suggestive of narrow braid tapes, a change which led, of course, t change in style of design. The tapey l were soon afterwards succeeded by othe which still further modifications in twis and plaiting threads made it possible t produce more important ornament consis of graceful flowing scrolls, interspersed details which suggest plant forms, as wel birds, animals, and the like. The pat from which the lace-makers worked were fully composed and drawn out by comp draughtsmen. By the end of the 17th cen lace-makers had attained to such excellen handicraft, that they could translate material, by their twistings and plait almost any kind of form, so that inste conventional scrolls and ornament we fi new phase or style in which botanical for particular are reproduced in filmy tex with great accuracy and realism. Whi

naturalistic and realistic laces many, at Mechlin and at Valenciennes, were ed in lengths, in complete lappets, col- cuffs, &c., others, as some from Brussels its neighbourhood, as well as places rance, were made in portions or separ- sprays only, which were subsequently oed together in accordance with a pre- mined scheme of the designer. It is this particular phase of making lace parate pieces that the making of Devon- sprigs has descended. But the descent d, as far as I can make out, with the idea of producing sprigs by themselves ut a clear plan of how they were to be d to one another to compose a pattern. when made up in much of the Devonshire of the late 18th and early 19th century, became fortuitous concurrences of miscel- us details. A poor style was thereby lished, and its influence, where it prevails present day, militates against success evonshire lace in competing with foreign that involves no greater cleverness of s in twisting and plaiting threads into es.

this point I introduce a series of lantern to illustrate the successive historic types e ornament to which I have referred.

egin with two pages from a Venetian n-book of the late 16th century. The first s two insertions; the style of ornament is upon the varied use of concentric circular s and radiating lines; it is purely etric.

second shows a series of tooth shapes dykes with simple symmetrical arrange- of lines and geometric devices. These kes were used sometimes as edgings to collars and cuffs, and sometimes as ons to the geometric lace insertions, in latter case the insertions combined with gings, became broad borders of lace.

his portrait of a Duke of Savoy—painted 2—we have an example of a linen ruff ed with the simple cord-like and wiry- g lace.

e is a portrait of a Countess of Hainault oreelze—painted about 1600—in which dy's stiff, upstanding ruff consists only wiry-looking geometric lace (Fig. 1,).

texture of such geometric lace is fairly hown in this slide made from a table- with an insertion and tooth-shaped ing of the lace. This probably was made early in the 17th century; and I think that it represents the texture and appearance of that contemporary kind of work which in Devonshire was known as "bone lace." Although there are not to my knowledge any authenticated specimens of "bone lace," some early 17th century sculptured monuments bear well preserved indications of geometric lace, as upon a monument to Lady Pole in Colyton Church, dated 1623, and upon another to Lady Doddridge (1614) in Exeter Cathedral.

Lastly, in illustration of this kind of lace-making—the only one prevalent at the time—the next slide displays other specimens of it made according to carefully designed patterns. All of them are not of twisted and plaited thread—bobbin or bone work—some being of looped thread work done with a needle.

The type of texture and ornament in the lace which succeeded the geometric wiry fabrics were, as I have mentioned, fuller and flatter: a restrained geometrical character of ornament is not adhered to, and the devices of pattern become changed although still distinctly conventional. The lady in this painting by Rembrandt (about 1640) wears a fichu bordered with scallops of the tapelike lace, very simple in design, but much more pliant and soft looking than the earlier geometric lace.

This painting of about the same date, gives another variety of pattern in this kind of lace.

And a richer variety is shown in the large falling lace collar worn by Queen Henrietta Maria. This is probably from a painting made about 1635. The pattern of the tapey lace here is more open than that in the two previous portraits: and this opening out of pattern led to another type of lace—more or less tapey in texture—but showing new development in ornamental design.

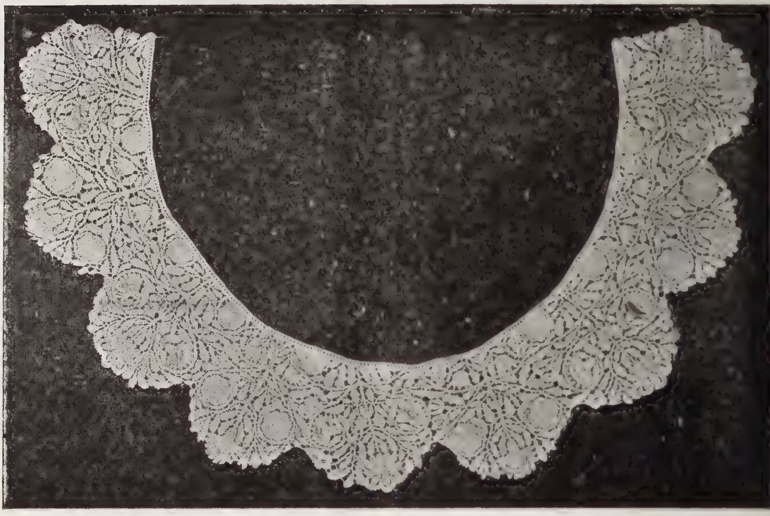
Here is an example of this. There are in it scrolls and forms suggestive of flowers, leaves, and suchlike. Each were made separately, though designed to harmonise into a single piece, when joined together as they are by means of little bars.

By referring to such a portrait as this by Gonzales Coques—painted in 1664—we fix the date when this style was in vogue. Of the same period is lace in which mesh grounds are introduced. Here we have fine scrolls and foliations of tape-like texture forming an open ornament in combination with a ground of meshes.

This next slide shows us a highly elaborate design of foliated scrolls: amongst them occur such forms as those of birds, a lion, a sportsman, a cupid. But each is so well

designed and treated as a component of an ornamental composition that it falls appropriately into its appointed place in the whole design. The texture is perhaps more like fine linen than tape; it indicates a progress of lace-making in passing on to a fine filmy material. Before leaving this phase of the tape-like texture, however, I must show you a charming piece of such material, made with the needle and quite possibly in Devonshir[e i]n the 17th century. (Fig. 2.) It is a scallo[pe]d collar. Its pattern is composed of floral fo[rm]s such as roses and carnations, which ar[e so] wrought as to give an almost realistic effe[ct t]o their petals, &c.

FIG. 2.



SCALLOPED COLLAR OF NEEDLE-POINT LACE, ABOUT 1640. ENGLISH.

FIG. 3.

FLOUNCE OF DEVONSHIRE PILLOW-MADE LACE, ABOUT 1820-30.

For examples of more pronounced real[is]tic effect we must pass to laces of the early [an]d middle parts of the 18th century, when

made in considerable quantities in
ıders and France.

n this slide we have two lappets. That on
eft is considered to be of Devonshire early
century make. It is of fine thread, and
careful workmanship equal in these
ects to Brussels lace of the same period.

one piece, and is of Mechlin work. Here the realistic appearance of the flowers is obvious. They are intermixed with fantastic rococo ornament, and tastefully blended into a design by judicious observance of balance in general massing or groups of form, and of contrasts, between fillings and plain meshes.

FIG. 4.

SS OF DEVONSHIRE PILLOW-MADE GUIPURE AND APPLIQUÉ LACE, PRODUCED UNDER THE SUPERVISION OF MISS TREVELYAN FOR THE ST. LOUIS EXHIBITION.

vas apparently formed in separate pieces
ch were subsequently joined together; the
ıralism of many of the details is gracefully
cated, though others are too fanciful to be
n as realistic renderings of actual plant
1. The lappet on the right was made in

Here again are two more 18th century lappets, which illustrate other varieties in this class of realistic floral designing.

The last specimen of this sort of design is a jabot worn by a man: a large piece of lace which hung in folds from beneath his chin over

his chest. It is an important bit of designing, and no lace-maker could have attempted anything of the kind unless she had been supplied with a very carefully made pricking from a well-drawn design.

The effect of using a poor design will be seen even in such minor details of Devonshire lace as those given on this slide. These pieces were made in 1820. Similar effect is noticeable in this large flounce of Devonshire work, produced probably about the same time. (Fig. 3.) The general arrangement, and contrast between closely and sparsely grouped forms, make for some effectiveness; but the want of drawing in the forms and details has resulted in feeble caricatures of flowers and blossoms and nondescript twirls and loops which, with their haphazard mingling, seemed to me to have less ornamental value than the patient repetition of notches on the paddle of a South Sea Islander. Nevertheless the dexterity of the lace-maker is unquestionable in producing an even texture by plaiting and twisting threads together. This quality of manual dexterity is, I think, to be recognised in these other specimens of Devonshire lace. The upper piece was made about 1850, and the lower one a hundred years earlier, probably. The pattern in it was apparently derived from some Brussels design—of which, however, it is but a grotesque version. There are evidences all through the piece that the lace-maker was adept at making small converging forms and larger expanding ones in an even texture. Such adeptness and skill would not have been taxed in any way had the convergencies and expansions been used to interpret graceful and intelligible shapes. At the same time the primitive and probably unintentional grotesqueness of pattern in this border is preferable to the pretentiousness of the design for the collar: which is, again an example of sprigs worked independently of a controlling idea that they must bear due ornamental relation to one another, in order to secure the attractiveness of unity and harmony. Some pretty specimens of sprigs from nature, worked forty years ago at Seaton, are shown in this slide, and are excellent in texture, and in their imitation of nature. But it would be as useless to expect to convert them successfully into the components of a rationally constructed, ornamental composition, as it would be to take separate and independent sentences and form them into a sensible paragraph.

I think that the lesson one learns by comparing ordinary specimens of Devonshire lace with kindred specimens made abroad, is t the foreign lace-maker has almost always well considered patterns to work from, that the Devonshire lace-maker has not. certain number of persons have realised condition, and the importance of its influen upon the fortunes of lace-making in Dev shire.

More than two years ago, the cou council of Devonshire appointed a spe sub-committee to consider the condition of lace industry, and the best means of devel ing it in East Devon. The report of this c mittee was issued at the end of 1902. committee mention certain signs of vitality in industry, and express the hope that these " not prove of a mere transitory nature, es cially if steps are taken to give further instr tion, not only in the art of lace-making, also in the production of improved pattern " The industry is, so to speak, endemic in county; it is especially a cottage indust, which may afford additional earnings to families of the county labourers." The rep deals with other matters connected with question generally, which I need not h touch upon. The result of the report is mai that the county council have set aside a sm sum to assist the development of classes instruction in lace-making, and have appoin an instructress to give and to organise su instruction. Under her, classes are now work at Honiton, Colyton, Beer, Bicton, Wo bury, Sidbury, and Branscombe. Lace-maki is also taught to sixteen children at the Pu Elementary Schools at Honiton, and to twe children at the Church School at Beer. It obviously a subject of suitable manual instr tion, which may educate the children's facult of neatness, observation, perseverance, a attention, especially if the steps in the cou of the instruction are gradual and well rela to one another, and due provision exists developing the individual abilities of ea child. I, myself, think that in the v earliest stages of instruction it is essen to use well-drawn patterns, no matter h simple they may be. I also venture to th that these patterns cannot wisely be as a matter of course to be devised by teacher, who, as a rule, is doubtless exp in twisting and plaiting threads into variet of textures, but not necessarily a quali designer. Seventeen years ago, when visited lace-making villages in Devonshi and reported upon them, I was struck by answers I received from competent lace-mak

o could teach the technique of the work, t who seemed to me to possess vague ideas design, and practically no power of accurate ughtsmanship. A good deal of their in- ration for design was derived from the wall- pers in their cottages.

The design side of the industry, however, is ing looked after by the county council: for committee have recently invited art schools d students in the county to submit designs itable for Honiton lace sprigs, and for a lar into which the sprigs may be intro- ced; and are offering prizes. These signs were not due to be sent into the unty council until 31st January last, d how far they may prove to be suit- le has not, I believe, been yet ascer- ned. But this branch of the general move- nt, undertaken by the Devonshire County uncil, should certainly lead to satisfactory ults in course of time. So far however the present is concerned with the supply of ucationally sound patterns for use in the sses aided by the county council, I cannot p thinking that the best that can be ained should be obtained. The source of pply should not be limited to the Devonshire t Schools which, up to the present, have not ne much in the way of designing for lace.

A few years ago the late Sir Cuthbert Peek, his interest for the industry, asked me to p him in getting new styles of design, ecially with the object of trying new ex- iments. A Devonshire designer could not found readily, so we brought in the services some Irish designers. The patterns they t over seemed well suited for the experi- nt. Sir Cuthbert placed them in the hands, hink, of Mrs. Fowler, of Honiton: and in urse of time a handkerchief border or two re made with success, both as regards dainty ture and pleasing effect. One or two other l bits were also produced, and these I will v throw on to the screen as evidences that, vever much Honiton lace-makers may be d to be wedded to their traditional patterns, y are well able to make good lace from ers. I do not suggest that these bits are a style that everyone will admire, or that d be adopted. They are nothing more than ggestive, that traditional forms and tra- ional fillings and enrichments, all of which singularly limited, may be dispensed with, d need not continue to stand in the way of velopment and progress. Other well-known alers in lace have, from time to time, made of designs which are not of Devonshire origin or tradition. The late Mrs. Treadwin, of Exeter, who has been succeeded so worthily by Miss Herbert, frequently caused some very remarkable laces to be made. Of such I have a slide to show. Upon it are three examples. The upper one is from a design which was especially prepared for Mrs. Treadwin. It is admirable both in texture and in the rendering of the forms employed in it. I think that without imterfering with the necessary scheme of the composition, there might have been more variety in the subser- vient details. It seems to me that it is indis- pensable for ultimate success that judicious variation should enter into all designs for hand-made lace. It is thereby lifted away from that class of lace which machinery can imitate, with commercial profit.

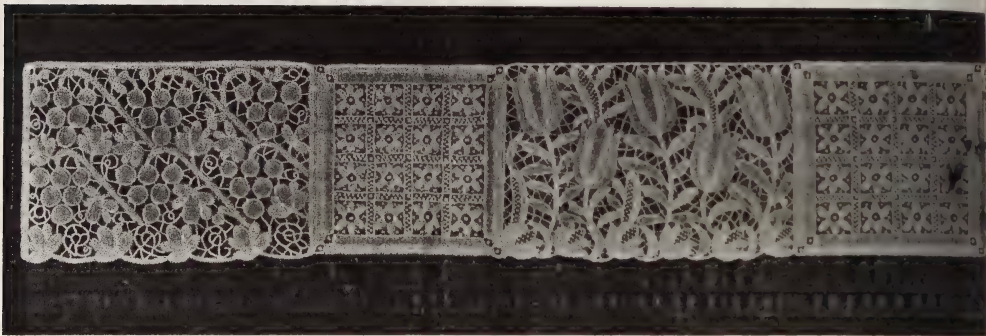
The centre piece of the three on the screen is an extraordinary careful reproduction of a late 17th century needle-point lace. Indeed it is so good, that by the great number of lace amateurs it would be indistinguishable from the original French or Venetian lace. Such reproductions are justified by the occasional demand which occurs for them. For ordinary trade purposes, however, the practice in making them is probably a mistake since the copy is almost certain to be inferior to the original. As a discipline in careful workmanship, making precise copies of parts of old laces of high standard is valuable. But this of course is very different from encouraging high-class experienced workers to produce slavish copies of old laces.

The third and lowest of the three pieces is one of such slavish copies. It is from a Brussels lace of the late 17th century which was cut into, unfortunately, and the conse- quent mutilations of forms along the upper part of the border have been imitated. There does not seem to me to be much virtue in such imitation. It encourages an impression that mutilations in old specimens are venerable characteristics of departed styles.

The Royal Commission for the St. Louis Exhibition, which is to open on 30th April next, decided to form a small representative collection of British laces, and a section of it consists of a selection of the latest speci- mens of Devonshire lace. These specimens have been contributed by Miss Trevelyan, Mrs. Bernard, and other ladies, as well as by some of the well-known lace dealers at Exeter, Sidbury, Beer, and Honiton. All have been made from fresh and carefully prepared designs.

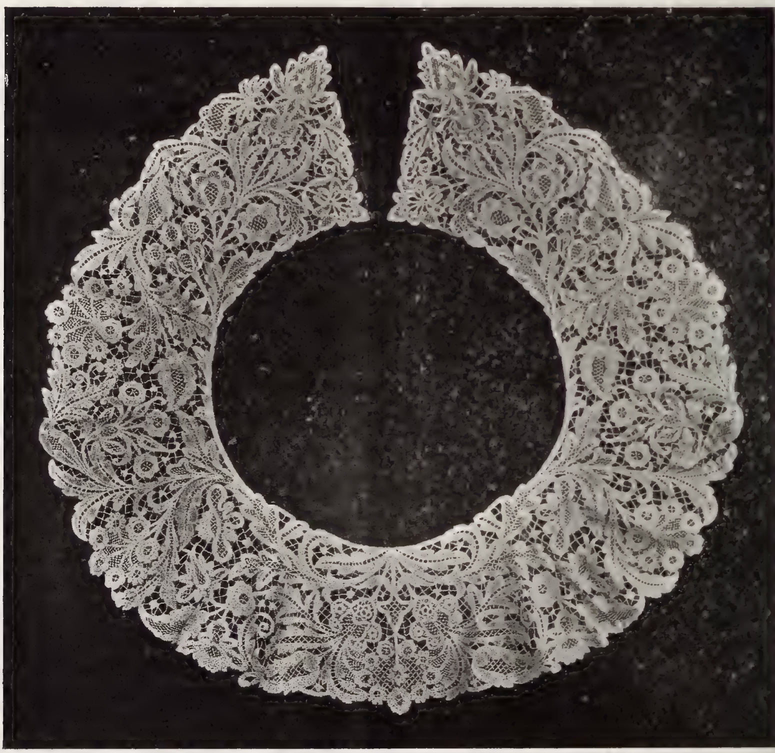
The lace dress (Fig. 4, p. 429), not at all sufficiently shown by this slide, is the largest and most important of the St. Louis exhibits of

FIG. 5.



PART OF AN ALTAR BORDER, DESIGNED BY MR. WALTER CAVE, AND WORKED BY LACE-WORKERS UNDER THE DIRECTION OF MRS. PEARSON, OF SIDBURY.

FIG. 6.



COLLAR OF DEVONSHIRE PILLOW-MADE GUIPURE LACE, PRODUCED UNDER THE DIRECTION OF MRS. COLLIN-BEAR.

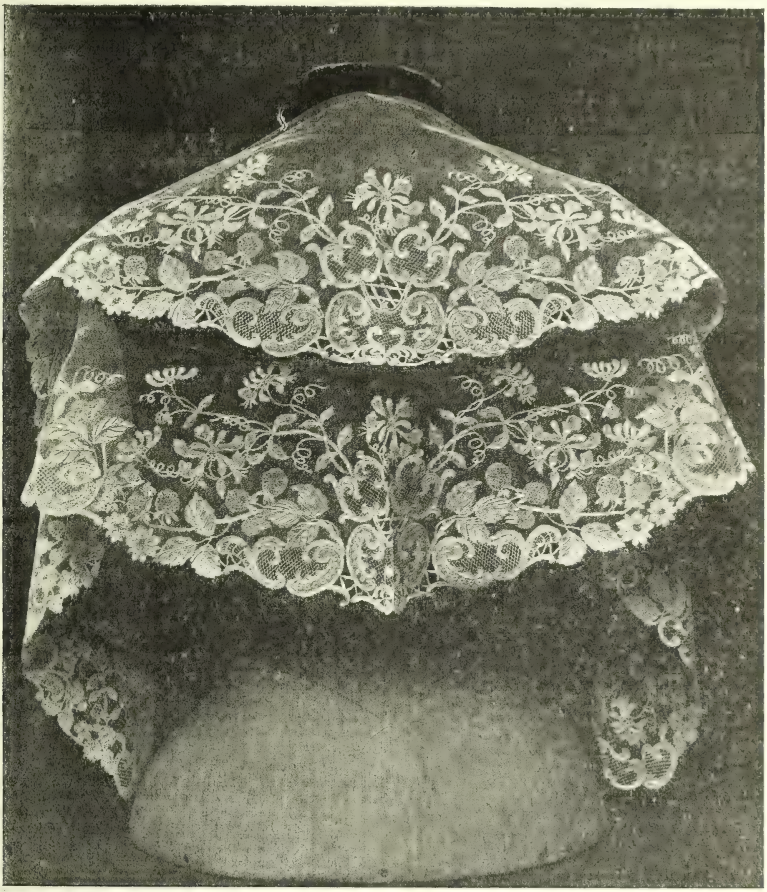
Devonshire lace. Its initiation is due to Miss Trevelyan. Notwithstanding the short time in which she launched and carried out her project, its success is, I venture to say, very considerable. After settling the main features of the dress, Miss Trevelyan secured the services of a distinguished student at the Taunton School of Art, who had proved her talent as a lace designer by winning the gold medal offered for

his branch of ornamental work at the national ompetition, conducted under the auspices of he Board of Education. The various drawigs were pricked by a skilled hand, and then istributed amongst several workers. As the eparate pieces were completed they were nited and made up into the dress now before s. The larger part of it is of sprigs—uniform

from Mrs. Collier, of Beer, who, on the advice of Miss Trevelyan, made use of a design prepared by Mrs. Mason, of the Taunton School of Art.

The concluding examples which I have to show, are of laces made under the experienced supervision of Mrs. Fowler, of Honiton. The first one is a fan made for H.R.H. the Princess

FIG. 7.



DOUBLE FICHU OF HONITON PILLOW LACE, MADE UNDER THE DIRECTION OF MRS. FOWLER, OF HONITON.

s to style but varied in form—applied to net, nd the broad insertions and edging to the skirt re of Devonshire guipure.

The next of the St. Louis exhibits is part f an altar border designed by Mr. Walter 'ave for the church at the village of Sidbury. Fig. 5.) I have to show this in two slides. 'he lace was made by Mrs. Pearson, of Sidury. It is of beautiful workmanship.

This large collar of guipure (Fig. 6) comes

of Wales, from a design, I think, by Mrs. Fowler's niece. She is a skilful draughtswoman, and has charge of the drawings and prickings issued for use by Mrs. Fowler to her workers.

The next piece is a collar in which naturalistic sprays of convolvulus are the chief features.

The last example (Fig. 7) is similar in style of design, with branches of blackberries and sprays of honeysuckle.

Now these St. Louis specimens are practically the latest exponents of the new developments which are taking place in Devonshire. They are peculiarly encouraging, in the fact that they anticipate anything of the kind that will result from the operations of the county council, and may, therefore, act as a tonic to such future operations.

The prizes which I hope the county council of Devonshire will continue to offer for lace designs, cannot fail to stimulate art students at Teignmouth, Plymouth, and Exeter. I am glad of this opportunity to mention the earnest manner in which Mr. Finch, the head master of the Teignmouth School of Art, is giving attention to this matter.

I have purposely avoided making any particular comments concerning the influence of trade in developing the lace industry. Trade conditions are of a very special nature, and considerations in forcing or supplying a demand may not always harmonise with either artistic result or improved rate of wages to workers. Still, without trade the industry would not live. Philanthropy sometimes seems to think otherwise: and that she can rectify the back-slidings attributed to trade—and, at any rate, insure better payment for labour. But this usually proves to be an assumption of a hopelessly misleading character. It is on a par with the vague notion of starting a class without knowing what the class is intended to do. Philanthropy might, perhaps, find an outlet for her endeavours if she concentrated them upon the cultivation of taste and refinement, and their infusion into general demand: this might assist an output of better work — and, no doubt, with better work would come better returns. The hand lace industry is scarcely of such a nature as to become strong enough to give its followers what can be rightly called a living wage; but I believe that it has permanent value in country districts as a means of auxiliary wage-earning. In all circumstances, however, its educational and artistic environment must be well looked after, whether by trade, philanthropy, or local authorities, in order that it shall maintain its proper position well in front of machinery, and be enabled to compete successfully with sister industries abroad where the educational and artistic necessities were perceived two hundred and fifty years ago, and have ever since been cared for in a manner which, it seems, is only beginning to be realised in this country.

DISCUSSION.

Mr. HUGH STANNUS said he felt that, after interesting and valuable a paper as the one which they had listened, he ought to say wh occurred to him as tending to help forward the e which Mr. Cole and all well wishing persons had heart. He had been very much interested in M Cole's running comments on the typical patterns lace that he showed the meeting on the screen; a hoped that some of them would appear in the *Journ* so that lace makers in the West might have an oppo tunity of knowing what a great authority on lace, Great Britain, and probably one of the greate authorities in Europe, thought on the subject of la design. He liked Mr. Cole's ingenious idea of sho ing the portraits of persons with lace as a porti of the dress. He believed that many beauti old textile patterns would have been lost h it not been that they had been preserved in t pictures which we had in the National Gallery a in other galleries. He remembered, with reference that point, that there was a very beautiful effigy a cardinal—he believed that it was Zeno—in S Marco in Venice, and with the help of rubbi he had been able to obtain the whole of the patte on the robes. This pattern was modelled in relie in imitation of figured velvet, and it was quite possib to obtain a pattern in the manner he had describe and also from many other patterns which existed modelled effigies. Mr. Cole's remarks about t technique were of the highest value. With rega to the distribution, Mr. Cole pointed out very admi ably the want of variety. Not very many years ag having to cover a wall with a stencilled pattern, h (Mr. Stannus) made, first of all, a frame-pattern, an then six or eight different varieties of fillings, an played them about. He supposed that, if the pattern for the lace workers were arranged in that manner, that there should be a general framing form lik some of the forms that had been shown on the scree they might ask the workers or the designers Devonshire to fill the framings with varied patterns and in that way, while there would be a similarity the general framing of the lace, there would b the invaluable quality of human variety and th evidence of the human mind working in th fillings of the frames, which no machine, howev skilfully contrived, could produce. He noticed ho pathetically Mr. Cole spoke about the workers n being able to make a living wage. Mr. Cole seeme to think that lace-making must always be looke upon as an accessory of the employment of the hom dwellers. He (Mr. Stannus) had seen the same ci cumstances in Venice and elsewhere on the Continen where the home dwellers were working at weaving spinning, or lace-making. One grieved to thin that the makers of that beautiful lace, which was s much an evidence of the luxury and the refinement the present day, could not receive a living wage fro the people for whom they worked. He trusted tha

hrough Mr. Cole's influence, there might be obtained such a number of new designs, and not only new ones, but racy and original ones, that lace might be brought more into vogue, and that the money of the purchasers of lace, instead of going out of the country for foreign workers, should be spent on our own countrywomen. He had often noticed in looking at lace designs that the designers seemed to consider that a piece of lace existed for itself only; but he ventured to think that they should look upon the lace as only an accessory to the dress, and that they should consider how the lace was going to lie and to fit against the velvet or silk or satin, or other fabric with which it was worn. He believed that if they did that, they would see that patterns might be very much more simple, and also more effective decoratively, than they were at present, and, consequently, less costly and therefore universally used.

Mr. CYRIL DAVENPORT said that a great deal of Devonshire lace was made by sailors after their day's work. He wished to ask Mr. Cole a question as to one of the collars which he had shown on the screen. It was whether the first one which was represented was pillow lace or point lace. He thought that there were one or two bits of the collar which were certainly needle point lace, and he should like to know whether the whole of it was of the same sort, or whether there was a mixture in the collar of needle point lace and pillow lace. With regard to the specimens which were going to the St. Louis Exhibition, as representing modern designs and modern workmanship, he was afraid that he did not think very much of them; but he hoped that the encouragement which had evidently been given for the making of designs of lace would have a good effect. He was afraid that some of the modern designs were not what they might be.

Mr. THOMAS, of the Battersea Polytechnic, said that at that institution they had no proper lace school and did not teach lace-making, but they had made lace designs for Buckinghamshire, and Suffolk, and Northampton, and also for Irish lace.

The CHAIRMAN said: He need not expatiate on the merits of the paper they had been discussing with so much cordiality of unanimous appreciation. Mr. Alan Cole was a past master of the subject on which for nearly thirty years he had especially concentrated his studies and researches in connection with the history and present condition of the artistic industries of this country. They would all remember the publication by the Arundel Society in 1874 of Mr. Alan Cole's folio volume on "Ancient Point and Pillow Lace." That was followed by his Cantor Lectures and papers on the art of lace-making in 1881; on the arts of tapestry making and embroidery in 1886; on Irish lace in 1889; on Egyptian textiles in 1889; and on means for verifying ancient embroideries and laces in 1894; and in 1888 by his "Report on the Honiton Lace Industry to the House of Commons." Excepting the late Mrs. Palliser, whose delightful—the tautology must be excused—"History of Lace" first appeared in 1867, no one can speak with such authority as Mr. Alan Cole on lace, and alike in its practical, artistic, and historical aspects. He had unfortunately not seen the paper before it was read, and what he had to say on it was said on the spur of the moment, and suggested by observations made by others in the course of the discussion. As to the origin of lace designs,—it should be remembered that while lace as "needle point*," and "pillow" work dates from the 16th century, the word "lace," is the Old French *laqs* and *las*, which is an attrition of the Latin "laqueus" "a noose" [Compare *lasso*, also to de-*light*, *i.e.*, allure, and, delicate]† and in its earliest English use meant a snare; and then a line, string, cord, or thread used as an edging for clothes, curtains, &c.; or a plaited string for fastening stays [virgines "vincto pectore, ut gracilæ fient" Terence *Eunuchus* II., 3, 22] or shoes ["pedibus telaria nectit aurea" Virgil Æneid IV. 239]; or again a binding of gold ["Venys gold"] or silver tissue. Now lace in this last sense, *i.e.*, of cords and tapes of gold and silver applied decoratively in "loops," and scrolls, and bands, and in every form

* "Point" in the nomenclature of needlework means "stitched"; but "counterpoint" does not, etymologically, mean "counter stitched," although quilting [from the Latin "culcita" or "culcitra," "a quilt," through the Italian *coltre*, *coltrice* (Spanish *colcha*), and French *coulte*, *cuite*, *coutre*, *cuitre*] is worked by "back-stitching"; and, moreover, works out in its initial, simpler, forms in a criss-cross patterning like that arising from the "leading" of Gothic window panes. The genealogy of the word counterpane makes this etymology of "point" very clear:—Low Latin "culcita puncta," "an embroided coverlet," Old French *coutre-* and *coultre-pointe*, Middle French *contre-pointe* [modern French *courte-pointe*], and English "counterpoint" [Drayton, *Barrons Wars* (1603), vi., 43, Shakespeare "Taming of the Shrew" ii., 353], and counterpane. The word "cushion," sometimes derived from "coxa," the hips (*cf*: cubital), and sometimes connected with "cinctum" and its cognates, is undoubtedly nothing other than the Latin [diminuitive of "culcita"] "culcitinum," through the [Italian *culsino*], Spanish *coxin*, and French *coussin*. The embroided and painted counterpanes of Chalons were called *ras de Chalons:* and here Chalons is the origin of such terms as shaloon and saloo [compare Hindu *salu* "Turkey-red (cloth)"] to be found in the Old Records of the India Office as denominations of oriental fabrics. "*Ras*," in English "Rash," can be no other than the Hindi *reshm* "silk."

† Delicate, with the cognate lacuna, lacerate, lacustrine, lupine, lupin, &c., is direct from the Latin; while de-*light* is from the Latin through Romance and Old German. Some of the cognates of lace through Greek, Latin, Romance, and Germanic are lake [not the pigment], lagoon, lizard [? from the lace-like wrinkings on its skin, ? or because it appears out of cracks in the walls], ulcer, wolf—with such proper names as Adolphus, St. Bartolph, Bidulph, Ralph, Rudolph. The Greek roots of these words are *lakos* or *rakos* "a rag," *lakis* "a reut," *lakizo* "Itear," *lakkizo* "Idig," *lakos* "a wolf," *aulax* "a furrow": these words all going back to the Old Persian *vrach* "to wound," and *vehrka* "a wolf," and the Sanskrit *vark* "to wound," and *vrkas* 'a wolf."

of conventional design, on vestments, and hangings, &c., has been made and used in India from time immemorial, and was probably equally well-known in ancient Egypt, and Babylonia, and Assyria, and in Greece and Rome. Decorative lace of this sort was known in England, also early in the 15th century. Again it will have been noticed that the earlier examples, the Venetian examples, of lace shewn by Mr. Alan Cole, were of comparatively simple designs, there were spaces, breathing spaces, spaces restful for the eyes, between the decorative forms, and the decoration was frequently almost baldly geometrical. This is the true "opus araneum," or *labori d'aria* of the mediæval Latin, and early Italian writers. But in Mr. Alan Cole's later examples, the Flemish and English examples of lace, and it is the same with the Spanish and Portuguese laces of the period, the patterning was closer, and more heavily wrought. In both there was the decided alternation of patterning to be found on all Oriental decoration, whether of architectural dados and friezes, or textile borders; and he therefore ventured to advance the suggestion that the designs of the earliest Venetian lace were derived from the Oriental embroideries, and fringe and tassel work, found by the Venetians in the course of their trade with Greece, the isles of Greece, and "the Levant" generally; and that the designs of the earliest Portuguese, Flemish, and English lace had their source in the oriental decorative textiles brought direct from the Persian Gulf, India, and the Indian Archipelago, in the course of the new trade with the East round the Cape of Good Hope, opened up by the Portuguese, Dutch, and English. The designs of our modern bookbinding came through Italy and the Levant from Persia; and again, the designs of the over-decorated wood carving of Holland in the 16th and 17th centuries were directly suggested to the Dutch by the stone sculptured decorations they saw on the temples of the Hindus in India. That is to say the earliest Venetian lace is based on the textiles, the carpets and hangings of Central Asia; and the earliest English and Flemish lace on those of India and the Indian Archipelago; and while in Europe we reproduced the "ground plan," so to say, of these Oriental border scrolls, we filled them in with the more or less conventionalised, or wholly natural forms, of our own flowers, and birds, and beasts. Then why was the modern lace industry successful in Italy, and France, and Holland, and why not, of all countries, in England? It was taken up with equal zest by the peasants of Italy, France, Spain, Portugal, Holland, England, Germany, Sweden, and Russia, and it succeeded in all these countries as a great artistic, opulent, and national industry, excepting England. The simple explanation is, that while on the Continent the new industry received the enthusiastic, persistently sustained, ubiquitous, and strenuous support of the Government, in this country it received scant protection from the Government, and but intermittent and insignificant patronage from the wealthy. The Governments on the Continent exerted themselves as eagerly and ingeniously to secure each other's choicest designs in lace by diplomatic begging, or royal borrowings, or downright theft, as they do to-day to pilfer each others naval and military schemes of mobilisation, and signal codes. In this way lace-making was rapidly carried to the highest artistic perfection in France, and became the source of ever-increasing wealth to that country, as also to Holland. There are several Acts of the 15th, 16th, and 17th centuries for the protection of English lace, but the lace referred to is gold and silver lace, corses, ribbons, fringes, tassels, buttons, cut work for appliqué embroiderery, &c., in fact, all kinds of passementery, rather than lace; and lace as we see it this evening is for the first time distinctly mentioned in Act xiv. of Charles II. as "foreign Bone-lace:" the adjective, "bone," here referring to the bobbins of bone with which the lace was worked; and beautifully carved "bones" of the 17th and 18th centuries are still to be picked up among the cottagers of Buckinghamshire, Devonshire, Lincolnshire, and other old centres of English lace-work. In short, nothing was ever really done by the State or by private patronage for the encouragement of the lace industry in this country, and wherever this beautiful domestic art still survives among us, it does so but in a languishing way; we meanwhile paying a large annual tribute to foreign countries for all the best lace we buy. It is something, therefore, that we are at last beginning to give some attention to the revival of this home industry, which, so far as any natural aptitude for it goes, is equally at home in England, Scotland, and Ireland. He said this not only because it was a profitable industry, but also on account of the vital national importance of the revival of rural life generally throughout this country. He did not, however, hope much from the action of the County Councils, or any such democratic organisations. Some one present objected to this expression of opinion, but he was not using the word democratic in the sense of party politicians, but in its etymological sense. There was no "cracy," no power of doing good thoroughly, *i.e.* strongly, and sustainedly, in the "demos"; and all the good that was ever done in the world was done by the strong, enlightened, and beneficent passion of the individual reformer. The wonderful efflorescence of artistic genius in this country in the 50 years between 1846 and 1896, would all have been wasted "in vacuo," and passed like the insubstantial pageant of a dream, but that the heaven-born man to organise it, and utilise it for the abiding national good, was present in Sir Henry Cole. Still it was right and well that the County Councils should exert themselves in this, and other like directions; and here and there, out of their efforts would happily arise gifted individuals, who would co-ordinate the public spirited labours of ladies like Miss Trevelyan, and Mrs. Collier, and Mrs. Mason of the Taunton School of Art, and give them a new and vitalising lead and trend:—for

"—a bold peasantry their country's pride,
When once destroy'd can never be supplied."

It remained for him to move the formal vote of thanks to Mr. Alan Cole; and he did so not only formally, but with all his heart, and, he was sure, with the whole heart of everyone present. They were indebted to him for a most valuable and most interesting paper; and it had naturally recalled to them the debt of gratitude every Englishman owed also to his illustrious father. The public appreciation of Sir Henry Cole's life work was every year growing greater and greater with the ever-enlarging and clearer recognition of the masterly and fruitful manner in which, through the resuscitation of the moribund School of Design at Marlborough House, and the absolute creation of the Great Exhibition of 1851, he brought all the artistic instincts and inspirations, and all the industrial activities of the country to a focus, and gave them an organisation and an influence, the effects of which throughout the United Kingdom and the Empire must now prove as enduring as they are beneficent. The whole artistic renaissance of this country began in 1842 with the publication of "Felix Summerley's Home Treasury and Illustrated Handbook." In 1845 he won the Society's Prize for the best tea and coffee service; the identical service from which your Council still drink the tea and coffee which is their perquisite on the occasions of their official attendances here; and in this tea and coffee service the whole series of the "Felix Summerley Art Manufactures," had their head spring. Again, it was Sir Henry Cole who organised the Society's Exhibitions in 1847, 1848, and 1849; and these exhibitions, under the guidance of Sir Henry Cole, with the co-operation of Sir C. Wentworth Dilke and Sir Digby Wyatt, and the assistance of Sir Francis Sandford, and Sir Philip Owen, and the enlightened support of the Prince Consort, led up to the Great Exhibition of 1851. Like all natural leaders of men—whether soldiers, sailors, statesmen, or social and political reformers, Sir Henry Cole was in all matters of national interest a stern and unyielding disciplinarian, and whenever a question of public duty or efficiency arose, he thought only of his duty and the efficiency with which it was to be discharged; and in this way he touched many susceptibilities, and raised many bitter controversies, now fast falling into oblivion. But while in the service of his country he was always Sir Henry Cole, in his private relations with men, as a man, he was always Felix Summerley, and all that that felicitous and inspiring pseudonym implied: a man who was the very genius of geniality, and the most tender hearted, and sympathetic, and helpful of personal friends. He was most generously helpful to himself [the Chairman] from the first moment of their meeting in 1871; and it had given him the liveliest pleasure to be present that evening, and preside over their meeting; and, if he might say so without presumption, to find Mr. Alan Cole sustaining with hereditary ability and vigour the reputation of the name he bears and so honourably upholds.

The motion was carried unanimously.

Mr. ALAN S. COLE, C.B., thanked the Chairman for the too flattering remarks he had made in proposing the vote. He also thanked the meeting for their thanks, and for the reception given to his paper, the reading of which had been a great pleasure to him. Referring to Mr. Stannus's remarks respecting the illustrations, he might say that the slides he had used, as well as specimens of lace in the Victoria and Albert Museum, were available for circulation by the Board of Education through the country, wherever they were wanted. With regard to Mr. Cyril Davenport's criticism on the St. Louis specimens, Mr. Davenport evidently aimed at a very high standard of design, which was doubtless charming to contemplate. His remarks, no doubt, might be justifiable, but he seemed to overlook the fact that the movement to improve designs for Devonshire lace was young. The specimens were good, and they were promising; they showed honest and sound effort, and if they did not rise to the very high standard contemplated by Mr. Davenport, they were distinctly commendable. As to the collar to which Mr. Davenport had alluded, it was entirely needle-point work of the 17th century. He could not say for certain that it was Devonshire work, but in his view it was not unlikely to be so, and there was no reason why it should not be. It was needle point lace. There were some few needle-point lace workers in Devonshire at the present time, and they worked specially for such people as Miss Herbert (Mrs. Treadwin's successor), and Mrs. Fowler, of Honiton. In the last specimen of lace but one which he showed, the ground work was made with a needle, and the details were made on the pillow. There was no particular reason why needle-point lace-making should not develop in Devonshire; at the same time it should be remembered that pillow lace-making was the more indigenous method.

Miscellaneous.

THE FISHERY INDUSTRY IN THE FAR EAST.

The fish caught on the Siberian coast formerly went to Japan as a fertilizer. The catch in 1902, as a fertilizer would have brought only £150,000, but by salting and curing the same fish and selling them at the lowest price, they brought three times as much. There are many different kinds of fish in these Eastern waters, but hitherto they have only been caught for local purposes, and did not pay for export. What is called "stock fish" was quite disregarded; no attention was paid to them. They are found in even greater quantities than the herring, and according to the United States Commercial Agent at Vladivostock, they seem to be waiting for foreign enterprise, the same as crabs and oysters,

which are taken only for the use of the poor inhabitants of the sea ports. The Government has laid down a rule that all persons engaged in the fisheries must be Russian subjects, and all the vessels employed must be Russian, sail under that flag, and have Russian crews. No fishing is allowed in the rivers, nor nearer than one mile from the mouth of a river. A severe penalty has been imposed on any Japanese found working in a Russian fishery, and Japanese were not allowed to sell fish to a Russian. The Russian Seal Company, the East Siberian Fishing Company, and one other company had the exclusive right to fish. In September last, one ship brought in a cargo of 37 tons of salmon from Okhotsk to the Vladivostock market. To illustrate the enormous quantity of fish in these waters, it can be stated that the agent of the Chinese Eastern Railway at Petropavlofsk reported recently, that while steaming along the western coast of Kamchatka, they encountered an immense quantity of dead "garbusha" (a kind of salmon) floating on the water. Though the steamer was going at the rate of 8 miles an hour, it took two hours to plough through the mass of dead fish which covered the water as far as the eye could reach. The phenomenon has been attributed to volcanic action, near or remote. One of the serious drawbacks to the fishery industry has been the cost of salt and the freight charges. In three months of 1902, the Kaiserling Whaling Company took 57 whales. In 1903, the same company killed 80 in ten weeks along the Korean coast. The catch of fish during the summer is estimated to be worth about £190,000. In the waters near Korsakofsk, on Sakhalin Island, the Japanese took in nearly three times more fish than the Russian fishermen. The catch of the local salmon ("kayta") has of late developed rapidly in the lower Amur fisheries. There are over 240 fisheries in the lower Amur, which employ over 2,000 men. In some of the fisheries over 1,800,000 pounds have been salted down in a season of six weeks to two months. The persons engaged in the fisheries live under the most unfavourable conditions, no interruption is allowed, and fishing, cleaning, salting, and packing, go on continually day and night. The lodgings of the men are only tents or huts made of boughs. The fish keep fresh but twenty-four hours, and much spoiled fish is salted down with the fresh. The fishing season of 1903 was good in all parts, and the prices received steadily advanced. One firm sent 20,160,000 pounds of fish to Hamburg, another firm supplied 6,480,000 pounds to the Japanese Government.

THE ITALIAN WINE INDUSTRY.

The decrease in the exportation of Italian wines to the United Kingdom has served to draw the attention of prominent producers to the fact of the variability in character and quality of the Italian product. According to Consul-General Neville Rolfe, of Naples, this arises from various causes, some of which are disappearing gradually. The first cause is that the wine has been largely made by ancient and rough methods by individual peasants, and, consequently, a constant quality was not to be expected and while the farmer would turn out a sonnd wine one year, the next year his wine would be quite undrinkable. This is now fast being remedied by the establishment of large firms, who make their wine on scientific principles, with proper chemical analysis, thus ensuring that the wine of one year shall be precisely the same as that of another; and this result can be more readily obtained when the wine is made in large quantities than when it is made in small lots. A second and very important point is that the Italian wine is usually bottled when it is too young, with the result that the fermentation is incomplete, and when the bottle is opened the wine, if not altogether bad, is not palatable. Effervescing wine is also said to be extremely liable to turn acid in the variable English climate, the effervescing wines of Italy containing a large proportion of sugar. This would not happen if the wines were kept long enough before being bottled. Consul-General Neville Rolfe says that there can be no reason why Chianti wine should not take the place of the lighter class of French wines, it has more body, and hence would be more suitable to the English climate. When pure, it is decidedly pleasant to the taste, and improves with age, being probably at its best when it has been five or six years in bottle, though it will keep sound a good deal longer. The Italian wines of the Burgundy type, so little known in the United Kingdom, might be vastly improved, and are being vastly improved by greater care in their manufacture, and there can be little doubt that Italian wines, properly made, rightly fermented and bottled with care, and especially with good corks, are much appreciated. America, both North and South, take a good deal of Italian wine; there is hardly a town of even secondary importance in the United States where the better known brands cannot be readily purchased, and there is no reason, according to the Consul, why this should not be the case in the United Kingdom. The output in 1901 was estimated at 968,000,000 gallons, and that of 1902 at 902,090,000. The 1903 crop is not expected to reach that of 1902.

Obituary.

FREDERICK GORDON.—Mr. Gordon, the chief organiser of the system of palatial hotels in England, which is now so general, died suddenly at Monte Carlo on Tuesday, 22nd ult. He was an old member of the Society of Arts, having been elected as far back as the year 1870. Mr. Gordon was chairman of the Gordon Hotels (Limited), and a director of the Frederick Hotels (Limited). He was also connected in the capacity of director with many other commercial enterprises.

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

NEXT WEEK.

Tuesday, April 12, 4.30 p.m. (Colonial Section.) Ben. H. Morgan, "The Regeneration of South Africa."

Wednesday, April 13, 8 p.m. (Ordinary Meeting.) J. C. Medd, "Agricultural Education."

Further details of the Society's meetings will be found at the end of this number.

SOCIETY OF ARTS MAP OF THE WORLD.

A map of the world has been prepared, showing the principal places outside the United Kingdom, in which members reside, and to which the Society's *Journal* is sent. The map has been produced by Messrs. George Philip & Son, Ltd., and indicates the principal steamship tracks, through lines of railways, principal naval and coaling stations, and the distances between the chief ports of the world. A copy of the map will be forwarded, post free, to any member who likes to apply to the Society's advertisement agents, Messrs. Walter Judd, Ltd., 5, Queen Victoria Street, London, E.C.

COVERS FOR JOURNAL.

For the convenience of members wishing to bind their volumes of the *Journal*, cloth covers will be supplied, post free, for 1s. 6d. each, on application to the Secretary.

Proceedings of the Society.

COLONIAL SECTION.

Tuesday afternoon, March 22nd; The Right Hon. Sir Edward Grey, Bart., M.P., in the chair.

The paper read was—

COTTON-GROWING IN THE BRITISH EMPIRE.

By Alfred Emmott, M.P.

The question of the growth of cotton in the British Empire has recently attracted the attention of all those who watch the development of our industries in general, and who recognise the importance of the cotton trade in particular. The interest attracted by the subject is emphasised by these words in the gracious speech from the Throne at the opening of this Session—

"The insufficiency of the supply of the raw material upon which the great cotton industry of this country depends, has inspired me with deep concern. I trust that the efforts which are being made in various parts of my Empire to increase the area under cultivation may be attended with a large measure of success."

The obvious fact is, that the demand for the raw material of the cotton industry has, in recent years, exceeded the supply, and that this relative shortness of supply has helped speculators to enhance the price of cotton to figures which have seriously interfered, not only with the profits but also with the amount of employment in the trade.

Last autumn, £2,000,000 was lost in wages in this country by cotton operatives alone, owing to short time and stoppages. At the present time the great majority of mills using American cotton are only working 40 hours a week instead of the normal 55½ hours, mills which, were cotton cheap and abundant, would all be fully employed.

During the last few months cotton has varied from 7d. to 9d. per lb. in price, and it is nearly 30 years since such prices were known.

It will be of interest at this point to show the variations in the price of middling American cotton from 1870, in five year periods.

Average Price per lb. Middling American Cotton on the Liverpool Market for Quinquennial Periods.

1870-74	(five years)	9·21
1875-79	,,	6·56
1880-84	,,	6·35
1885-89	,,	5·52
1890-94	,,	4·66
1895-99	,,	3·85
1900-03	(four years)	5·47

It will be noted that the quinquennial average price fell regularly and persistently until the period 1895-99. The lowest year was 1898, when the average price was 3·31d. It rose to 3·56d. in 1899, and 5·47d. in 1900. Afterwards there was a fall, and the average price of each of the years, 1901 and 1902, was about 4¾d. In 1903, it rose again to an average price of 6·03d., commencing the year at 4·68d., and ending it at 7·24d., and in the first week of February, 1904, the culminating price of the great speculative movement was reached, when the price stood about 9d. Since then the price has been lower, but there have been wide fluctuations, and much disorganisation in the industry.

There are two elements discernible in the increased prices of the last few years. The first may be called a legitimate rise of price due to an increased demand. The second is due to a singularly daring speculative movement on the part of a group of American speculators. It is quite impossible satisfactorily to separate the effect of these two causes.

I am sorry that I am unable to give exact figures of the consumption of cotton in the world, because an unknown quantity is used in hand-spinning in India, China, and elsewhere. The figures of production are much more reliable, and the essential fact of the situation is that there was not sufficient cotton in the year 1902-3 to supply the spindles of the world.

The world's crop returns for the past 25 years, given in annual averages, is as follows :—

Annual Average of the World's Crop of Cotton in Bales, in Quinquennial Periods.

1879-83	8,680,000 bales.
1884-88	9,600,000 ,,
1889-93	11,540,000 ,,
1894-98	13,360,000 ,,
1899-03	15,680,000 ,,

These figures must be taken as approximations. I am not sure whether the cotton grown in China and Asiatic Russia is accurately accounted for in the earlier years. It must be remembered, too, that the bales vary in weight, both according to localities and even in the same locality. For instance in 1879, the American crop was 5,074,000 bales of 434 lbs. each, whilst in 1903 it was 10,758,000 bales of 495 lbs. each. Egyptian bales contain about 700 lbs. of cotton each and the crop increased from 254,000 bales in 1879 to 825,000 bales in 1903. Bales of East Indian cotton weigh about 400 lbs. each, and the crop increased from 1,543,000 bales in 1879 to over 3,000,000 in 1903, whilst the production of cotton in the rest of the world, composed of many different varieties, increased from 167,000 bales in 1879, to 1,500,000 in 1903.

Mr. Hutton, to whom I must express my great acknowledgment for much kind assistance, in a paper read before the Manchester Statistical Society, February 10th, reduced the present crop of the world to bales of 500 lbs. each, and gives the number as follows :—

United States	11,000,000
India	3,000,000
Egypt	1,000,000
Rest of the world	1,000,000

These figures are for an average crop, and are in substantial agreement with the other figures I have given. They show that the present annual production of cotton is about 8,000,000,000 lbs.

Reverting once more to the Table showing the annual average of the world's crop of cotton from 1879 to 1903, it will be noted that the production of cotton has increased more quickly during the later years than during the earlier. The increase for the period 1884-8, as compared with the figures for 1879-83, shows a larger production of 920,000 bales per annum, whilst the increased growth for the last period of all over that immediately preceding is no less than 2,320,000 bales. It must be remembered that it is during this last period that the cry of scarcity of cotton has arisen, and the stocks of raw cotton have been depleted. It is, therefore, abundantly evident that the tendency towards an increased demand for cotton is still growing, and it is calculated that in five years' time, 19,000,000 bales of cotton will be wanted, and in 10 years, 23,000,000 bales against a present production of only 16,000,000.

The question of whence this increased supply of cotton is to come is of importance to the world at large; but it is of greater and more vital importance to Great Britain than to any other country. Our total production of cotton goods is estimated at £90,000,00

, £100,000,000. Of this amount, some 72,000,000 worth is sent abroad, and con-:itutes the greatest manufactured export trade f any kind of any country in the world. It is bvious that if this trade is to be curtailed by a hort supply of cotton, the results to us will be ery serious, and that not only directly, but in-irectly. Cotton manufactures play an im-ortant part in balancing some of our trading ccounts. We import a much greater value of oods from several of the great nations of the orld than we export to them, and in some ases even when shipping charges, the balance f interest due to us, and reasonable profits re allowed for, there is still a balance due by s, which must be paid for in some other way an by direct trade. Let me give an illustra-on, which I take from an article on the cotton dustry by a well-known authority, Mr. Elijah elm, Secretary of the Manchester Chamber Commerce :—

"Take the case of France. She imports large antities of raw silk and other products from China, pan, India and Turkey. Yet the amount of mer-andise exported from France to these countries in turn is extremely small, and assuredly she does not nd them gold. How, then, does France pay for ese liberal imports from the regions I have men-oned? She pays for them indirectly, not by means her own productions, but by sending her wine, her k goods, her gloves, and her artistic manufactures Great Britain, and Great Britain settles the account exporting her manufactures, chiefly cotton goods, the countries in question."

There is yet a further consideration in re-tion to our vast export trade in cotton manu-ctures. A sudden rise in price hinders ade in every country, but its effect is much eater in countries in a lower state of civiliz-ion. Much of our trade is done with Oriental barbarous races who do not take kindly to creased demands on their slender means, hilst the export of cotton manufactures to ch races on the part of our competitors is mparatively small. It is of the utmost im-rtance, therefore, on account of the magni-de of the trade itself, on account of its great efulness in helping to pay some of our bills roundabout methods, and on account of our eat export to uncivilized or semi-civilized ces, that we should strain every nerve to crease supplies of the raw material, and so eep its price at a reasonable figure.

The question now arises as to how this is to e done. So far as our troubles arise from bridled speculation, the best remedy that n be applied is to smother the speculators in cotton. I have never seen any feasible plan for stopping speculation by legislation. Few speculators in raw material have died rich men, and paper bargains in cotton are as useful to the cotton-spinner as to the specu-lator. The remedy for the short supply of cotton is the same as that for the speculator. We want more cotton grown.

This brings us to the consideration of what are the prospects of larger supplies from exist-ing cotton fields, but, if I am not wearying you with figures, I want, first of all to put before you some details of the growth and distribution of the American crop. You will remember that out of 16,000,000 bales, America produces 11,000,000, or approximately 70 per cent. There has been a great change in the distribu-tion of this crop in recent years, as well as a great increase in the growth. The total dis-tribution of the American crop for 1876-80 was 4,947,000 bales; for 1886-90, 6,878,000 bales; for 1896-1900, 9,664,000 bales; and for 1901-3, 10,762,000. The distribution was as follows :—

Distribution in Periods of Thousands of Bales.

	Great Britain.	European and other Ports.	U.S.A.	Total.
1876–80	2,151	1,245	1,551	4,947
1886–90	2,836	1,784	2,258	6,878
1896–1900 ..	2,944	3,310	3,410	9,664
1901–03	2,978	3,600	4,184	10,762

The above Table shows that England is using a much smaller proportion of the American crop than was the case years ago. This tendency has been very marked all through the last century. For instance, in 1827-31 we used 63 per cent. of the American crop; in 1852-6, 53 per cent.; in 1881-5, 43 per cent.; and in 1901-3, not quite 28 per cent. This decreased proportionate consumption of the American crop does not mean that we have used less cotton, but that other nations have used more. Exactly the same tendency is apparent in the con-sumption of the Northern mills of the United States, which used 1,840,000 in the three years 1888-90, and 2,256,000 in 1901-3, whereas the Southern mills used 490,000 bales in the earlier and 1,925,000 in the later period.

The tendency on the part of the United Kingdom to use a small proportion of the American crop is due not only to the increase of spindles in the Southern States of America and on the Continent of Europe, as well as in

Japan, Canada, and Mexico, but also to the fact that we now spin much finer yarns than we did some years ago, and use a good deal more Egyptian cotton. The American spindle spins about 90 lbs. of cotton per annum, the spindle of the European continent 70 lbs., and that of Great Britain 34 lb. Perhaps I may give at this point the number of spindles running in Great Britain, the Continent, United States of America, India, and other countries in 1895, 1899, and 1903:—

	1895.	1899.	1903.
Gt. Britain	45,400,000	45,500,000	48,000,000
Continent ..	28,200,000	32,500,000	34,000,000
U.S.A.	16,100,000	18,300,000	22,000,000
India	3,800 000	4,700,000	5,000,000
Others ...	—	—	3,600,000
Total	93,500,000	101,000,000	112,000,000

There are three observations to be made on this Table. First, the spindles of "other" countries were not all started between 1899 and 1903, but I have not accurate details of the earlier period. In the second place, the growth of spindles in India has been materially checked during recent years; and in the third place the growth of spindles in Great Britain has shown a greater increase in the last period than those on the Continent. It should be added that the increase in the United States of America is mostly in the Southern mills.

The danger of our dependence on American sources of supply is twofold. In the first place, if the increase in the Southern mills is to continue, a point which is somewhat in doubt, and about which I cannot speak with certainty, the demand for the market of the United Kingdom must become a more and more negligible factor. In the second place, unless the supply of American cotton is greatly augmented, we shall continue to be more or less in the hands of speculators.

I come now to the possibility of increased supply from existing sources. In reference to the United States of America, I am quite unable to forecast what may be done in the future, either in the direction of the increase of the total production, or of the proportion of that production which will be available for our use. There are two considerations to be borne in mind as regards the increase of production, firstly whether the acreage of the crops is likely to be greatly augmented, and, secondly, whether the growth per acre will show any material change. My opinion on the question of acreage must be taken for what it is worth, for reports are very contradictory. Judging by the past, I am inclined to believe that the acreage will be increased. In the three years 1877 9 the acreage as given by the Washington Department of Agriculture averaged about 12,500,000 acres; for the three years 1889-91 20,600,000 acres; and for the last three years about 27,600,000. The average price in this country from 1877-9 was 6¼d.; for 1889-91 5 9/10d.; and for the last three years 5⅜d. It must, however, be remembered that between 1891 and 1901 prices had been very low and afforded no stimulus to increased production. A careful study of the effect of prices on acreage during the past 25 years shows that when prices first dropped below 4d. there was a considerable decrease in acreage, which was more than recovered three or four years later, and when in 1900 prices rose materially, the tendency to increase again asserted itself in a marked manner. I cannot, therefore, help expecting that the recent range of high prices will probably have a stimulating effect. It has been shown that a price of 4d. in this market is a paying price to the American producer. *A fortiori*, 5d. or 6d., must pay him much better, whilst 7d. will yield a huge profit. Indeed, it seems to me one of the dangers of the situation that the present value of cotton may so stimulate production in America, that by the time we have got our new sources of supply to work, they will be prejudiced by a fall in prices. Such a fear ought not to deter us from doing all that we can to stimulate the growth of cotton elsewhere; for it is dangerous for us to be so dependent on the United States of America. Also there are many competent observers who think that the supply of labour in the South will prevent any large increase of the crop.

It is unnecessary to allude at length to the question of the yield per acre. There is a general impression that the yield in America is decreasing, but having looked somewhat closely at the figures, I cannot, at present find any justification for it.

Our next chief source of supply is Egypt. This cotton is longer, finer, and more silky than the American variety; it is more suitable for our finer manufactures, and lends itself to the newly discovered mercerising process which makes it look almost like silk. We are the largest consumers of Egyptian cotton, and obtain one-sixth of our total supply from that country. The Assouan Dam will, no doubt

lo something to increase the acreage under cotton. I understand, however, that Lord Cromer estimates that it will only increase the total cultivable area by 15 per cent., half of which is suitable for growing cotton. It will be seen, therefore, that no great addition can be made to the amount of cotton grown in Egypt.

We obtain a certain amount of cotton from Brazil and Peru. The quality is somewhat harsh, and although for many purposes these varieties can be used instead of American, our consumption of them has very materially decreased since 1870. The question of the possibility of an increased crop in those countries concerns other users more than ourselves. If more cotton is produced there, so much the better; but our spinners evidently prefer American cotton, and will only use Brazilian when they must.

There has also been a great decrease in the amount of East Indian cotton we consume. The length of the staple is very short, and it is quite unsuitable to the manufacture of any of our finer goods. One of the venerable chestnuts of the Lancashire Cotton Famine is the story of a man, who at a prayer meeting where someone was fervently praying, "Oh Lord, give us more cotton," ejaculated "Yes Lord, but please not Surat!"

Lancashire has certainly acted in accordance with that view, for whilst from 1870 to 1875, we imported over 1,000,000 bales of cotton every year from India, we have only imported about 100,000 per annum during the last six years. I shall deal with the possibility of further supplies from India when I reach the question of the work of the British Cotton-Growing Association.

This list exhausts our principal sources of supply, but we get small quantities of cotton from Chili, Venezuela, Columbia, the British West India Islands and British Guiana, European and Asiatic Turkey and a ton or two even from Australia and New Zealand. From none of these countries, however, has the supply of cotton suitable for our purposes been increasing of late years. Indeed, a cursory glance at the statistics of imports shows (1) that we were less dependent, just before the American Civil War, on supplies from the United States than we are to-day; (2) that we were then using large quantities of Indian cotton, which we can do no longer, because the competition of India, Japan, and China has taken from us the coarser trade; and (3) that the only great increase of supply has come from Egypt.

These facts have long been obvious; but I do not think traders would have awakened to the seriousness of the situation were it not that we were on the verge of a cotton famine in 1900, actually experienced one in 1903, and are face to face with the danger of another in the present year.

Having dealt with the present situation, the needs of the future, the probable insufficiency of present sources of supply to meet these needs and the danger of being so dependent as we are on the United States, I come now to the efforts that are being made to extricate the cotton trade from the dilemma in which it finds itself placed. This is not a small problem, it is a large one.

There are, at present, probably 45,000,000 to 50,000,000 acres growing cotton, or say, 75,000 square miles, or nearly two-thirds of the area of the United Kingdom. In ten years time, we want to have a further area, half as large again, planted with cotton. Let me put it in another way. Take a length of railway, about 30 miles. To keep one good modern mill running on ordinary medium counts would require a plantation extending for half a mile on each side of the line for the whole of that distance. In addition to the present area, the world will want at least another thousand such plantations within the next ten years. The value of the cotton produced on this extra acreage, at an average of 5d. per lb., would be £70,000,000, or, at present prices, over £100,000,000. What a stimulus to the trade of the Empire if we can grow even half of it in our own possessions!

We have in the British Empire almost endless territory suitable for the growth of cotton. It would be a clear Imperial gain that we should grow it there, for whilst the extra cotton would supply our mills and discourage speculators, the people who grow it would become excellent customers for our manufactures.

The British Cotton-Growing Association has been formed to try to achieve this desirable end. Its inception was due to the Oldham Chamber of Commerce and to Sir Alfred Jones. At the annual dinner of the Chamber in January, 1901, a discussion took place on the important question of increasing the world's supply of cotton. Subsequently a committee was appointed to make inquiries, other Lancashire Chambers of Commerce were approached, and a meeting was held on February 18th, 1902, at the Manchester Chamber of Commerce, of those interested in the question. Sir Alfred

Jones had meanwhile been dealing with the question with his usual energy. In May, 1901, he sent out ten tons of seed to our West African Colonies; he impressed on the governors of those colonies the importance of increasing the growth of cotton there, and, with a generosity no less real because it may eventually prove to have been far-sighted, he offered special facilities for the shipping of the first thousand bales of cotton that may be sent to this country.

The African section of the Manchester Chamber of Commerce was invited early in 1902 to appoint representatives on the Oldham Committee, and these representatives soon saw the necessity of co-operation between the Oldham movement and Sir Alfred Jones. On May 7th, 1902, a meeting of all those interested was held at the Albion Hotel, Manchester, and at that meeting the British Cotton-Growing Association was formed.

On June 12th, the Association was publicly inaugurated, and it was decided to raise a guarantee fund of £50,000 for the purpose of making the necessary preliminary inquiries and of undertaking experiments and providing machinery wherever it seemed advisable. The merit of the work in its earlier stages is principally due to Sir Alfred Jones and to Mr. J. E. Newton, of Oldham, whose health, unfortunately, has broken down under the strain of the work which he undertook as chairman of the committee of the Association.

Before proceeding to describe the work done and information obtained by this Association, I may mention that the original scope and intention has had to be greatly enlarged. Instead of a guarantee fund of £50,000, it is now intended to raise half-a-million; instead of isolated experiments, expert advice and presents of solitary gins, one or two considerable plantations and large advances to cultivators are under consideration. Great encouragement has been received from Government officials of all kinds. The drawbacks have been, firstly, the lack of response on the part of the bulk of the cotton trade, but I hope this will now be altered; and secondly, the fact that the Association has been so overwhelmed with correspondence and appeals from all tropical and sub-tropical parts of the Empire, that it has been difficult to concentrate its attention, or even decide wisely on what seems best worth doing.

I will now take the different parts of the Empire in which cotton can be grown, and state very briefly what has been done and what it is hoped to do.

India was the original home of the cotton trade. Even the word "calico" comes from India, and the finest muslins have been made there from time immemorial. So far, little has been done by the British Cotton-Growing Association for India beyond holding many interviews with officials and conducting a large correspondence. The Indian sub-committee of the Association believes that much may be done there. On February 27th, Mr. Brodrick, the Secretary of State, kindly granted an interview to a deputation. He made the interesting suggestion that the British Cotton-Growing Association should start a plantation in Burma and try to produce a better quality of cotton there. Several earnest attempts have been made in the past in this direction in other parts of India.

All the various kinds of cotton grown in India at present are, however, too short for general use here. In the old days we used them largely for coarse counts and coarse cloths, which were sent to the East; but India can now make these more cheaply for herself.

Three things stand in the way of any great growth of cotton in India suitable for our purposes. The first is that exotic seed has never yet been successfully cultivated there for any long period. It seems as if in regard to cotton, the soil forces the product of the seed into some primeval type of its own choosing rather than gives it fair play to reproduce its own prototype. The two other difficulties are removable. One is that sufficient care is not exercised in the selection of seed, and this is vital for growing good cotton. The other is the primitive methods of cultivation used by the Indian ryot. How long it will take to remove them, I leave to those who know India better than I do to judge. I can only say that many practical men still hold the strongest opinion that India might and ought to produce cotton of a better quality and far more per acre than she does. Let us hope their opinion may be justified in the future.

I take next the West Indies. In 1786 to 1790, we received from the British West Indies, British Guiana and British Honduras, 45,000 bales a year out of a total consumption of 63,000 bales, whereas of late years we have not imported more than 1,000 bales of the same size. In these Islands can be grown the very finest kind of cotton which is used, commonly known as the Sea Island variety. I am glad to say the movement for an increased

growth of cotton has been taken up with great enthusiasm, many thousand acres are planted, and next year the acreage will be still greater. Sir D. Morris, the Imperial Director of Agriculture, is taking the deepest interest in the question, as is also Sir Gerald Strickland, the Governor of the Leeward Islands. The impoverished condition of landowners has made many of them unable to undertake the growing of cotton without financial assistance, but by the aid of the Colonial Office it has been arranged that grants shall be made to respectable planters, under the joint guarantee of the local authorities and the British Cotton-Growing Association.

Correspondence is being carried on with Australasia, Ceylon, Burma, Borneo, and Fiji, and some experiments are being made in Ceylon. In reference to Australia, where there are great areas of land suitable for growing cotton, the difficulty lies in the great cost of the production of cotton by means of white labour.

I turn now to our possessions in the vast continent of Africa, by far the most hopeful field of all. I have already dealt with Egypt, but have not mentioned the Egyptian Soudan, the ownership of which we share with Egypt. Dr. Hagberg Wright wrote to the *Times* on January 5th, enclosing a letter from a friend of his in which this extract occurs :—

"The inverted alluvial delta of the Egyptian Soudan, which is situated between the White and the Blue Niles, is even more favourable to the growth of cotton than the lower parts of the Nile Valley, and affords ten times the area for the plantation of cotton of that available in Egypt proper."

I find, curiously enough, this statement was made thirty years ago in a book by Mr. Isaac Watts, the Secretary of the Cotton Growing Association of that day.

Experiments have already been made at the Shendi Experimental Farm, of which an interesting account is given by Mr. J. Nevile in "White Book, Egypt" (No. I., 1903). It seems quite certain that when the Suakim-Berber Railway is open, cotton can be grown and sent to Europe at very reasonable rates. The Association has constantly pressed upon Lord Cromer, through the Government, the necessity for building this railway with as little delay as possible, and he has promised that this shall be done. The principal difficulty one foresees is the question of labour; but in these days of wholesale immigration from other countries, is it too much to hope that it may be possible to attract some of our Indian fellow-subjects to settle there?

A new field of cotton has also been opened in the neighbourhood of Tokar, on the Red Sea. From 20,000 to 30,000 acres are already under cultivation, and it is said that this area will be greatly increased in the future. It is also stated, that if the Khor Baraka were dammed, some 2,000,000 acres of land would be cultivable between Tokar and Kassala. On the whole, the Egyptian Soudan is one of the most hopeful fields for the growth of cotton for the United Kingdom, because it is capable of producing, apparently at a reasonable price, cotton which is long in staple and fine and silky in quality.

Going further south in Africa, we come to Uganda and British East Africa. The Foreign Office has sent an expert there, and Sir Charles Eliot reports that there is plenty of good cotton land, and a supply of cheap labour. It has also been shown that cotton can be grown there from Egyptian seed quite as good as that grown in Egypt proper, but the cost of growing on a commercial scale has not yet been proved.

Again, going south, British Central Africa is the next available field. Here there is a wild cotton plant (*Gossypium anomalum*), and a plant introduced by the Arabs (*Gossypium herbaceum*), which has been cultivated intermittently for centuries, but the best cotton in this district is grown from recently imported Egyptian seed. It is nearly fifty years since Livingstone was despatched to the Zambesi and Lake Nyasa, to open up the country to cotton growing, for a cotton famine was threatened in the fifties and, as the world knows, actually took place in the sixties. The chief obstacles to Livingstone's schemes lay in transport difficulties. During only six weeks in the year is the Zambesi-Shiré navigable to the verge of the Shiré Highlands. The railway which is being built from a point on the navigable Shiré through British Central Africa to Lake Nyasa is meant to meet the difficulty.

The present situation is this. Cotton is being grown successfully, and can now be put on the Liverpool market at 4½d. to 5d. a pound. On the table are samples of two kinds of cotton grown from Egyptian seed, which have been sold recently in Liverpool at 7⅝d. and 8½d. per lb. respectively. These samples were sent to the Society of Arts by the African Lakes Corporation, Limited, who imported the cotton. Labour, however, is not too plentiful,

and that "Imperial" policy which is depriving this district of its labour in order to work a few more stamps in South African gold mines, is going to make it less plentiful than ever. This policy seems likely to delay even the completion of the railway, which is a necessity of the first importance. When the railway is built there is an enormous territory waiting for development. Even under present circumstances some advances have been made to cultivators, and if sufficient funds are forthcoming, it is in contemplation to advance £100,000 or £150,000, in order that 100,000 acres may be put under cultivation.

It is important to remember that men like Sir Harry Johnston, who knows this district well, and who recently sent a letter to the *Times* from which I have largely borrowed, are the most keen and enthusiastic about cotton-growing in this territory.

The only other British possession on this side of Africa which I need name is Rhodesia, in which experiments are being made by the British South Africa Company, with considerable hope of success.

Turning now from East to West, it is unnecessary that I should tell you cotton can be grown in Gambia, Sierra Leone, Lagos, Southern and Northern Nigeria, as well as in the French and German possessions in that region, in the Cameroons and Congo region. The only question is the extent to which it can be grown, and the price at which it can be put upon the English market.

In Gambia an experimental farm is being started, but it is not an easy matter to induce the natives to take up anything new. Some very fair samples of cotton have been grown. Gambia possesses an excellent waterway, and it is important for this colony to cease to be so dependent as it is on ground nuts.

There is a larger field in Sierra Leone. Experiments have been made with American seed, but the result is still doubtful. The best cotton sent home so far has been a native variety. The British Cotton-Growing Association has been fortunate in securing the services of Mr. Shelby Neely, an able young American from the Mississippi Valley; three expert black farmers have also been sent out, and every effort is being made to ensure progress.

We now come to the Gold Coast Colony. In part of the colony, labour is so fully employed in gold-mining, that the supply is short and the cost is high. At the same time, it must be remembered that there is much good cotton land, and that, in spite of the difficulties to which I have alluded, another new industry has sprung up there in quite recent years. The export of cocoa, which was almost an unknown article ten years ago, has increased some thousands per cent. in a very short time. Let us hope this may be the case also with cotton.

Passing by Togoland, where the Germans, with their usual scientific thoroughness, are trying to establish cotton cultivation, and the French colony of Dahomey, we arrive at Lagos, a most hopeful field. Here is a large and intelligent population, already interested in agriculture and acquainted with cotton cultivation, if only by primitive methods; there are large tracts of undulating land in the Hinterland; there is a railway slowly, if most expensively, wending its way into the interior; there is a Governor (Sir William MacGregor) who takes a great interest in the question, and there are experts who are very sanguine about the future.

Unfortunately, a good deal of ill-feeling has been caused by the revival of the old custom of levying octroi dues in Abeokuta and Ibadan. I state this as a fact; but express no opinion on the merits of the case. Much of the seed recently sent out was not sown, and progress has not been so quick as was hoped. There was also a deficient rainfall in 1903. The needs of the future are the extension of the railway beyond Ibadan towards Ilorin, and if the colony cannot afford to carry out this work, it is distinctly a case where Imperial assistance, either by funds or guarantee, should be given.

Cotton has been grown here for export in the past, but, owing to the fall in the price of American cotton, the trade ceased to be profitable. Mr. Hoffman, one of the experts to whom I have alluded, reports most favourably of the care given to the cultivation of the plant in the Ekití country in Yorubaland, but he insists on the want of means of transport in the interior, and on the consideration that the price paid to the native for cotton must not fluctuate, "as the people are not in a condition to meet such changes."

Adjacent to Lagos is Southern Nigeria. An expert, Mr. Prince, was sent out there, and he cleared and cultivated a plantation of 50 acres close to Onitsha on the Niger river. A large sample of this cotton has been sent home, and is said to be exactly what is wanted in Lancashire. It is in contemplation to make a large plantation on the Sobo plains in Southern

Nigeria. The Government has offered to defray the cost of making a scientific analysis of the soil, and has also placed at the disposal of the British Cotton-Growing Association the services of Mr. Hitchens, who has had a large experience of the agricultural possibilities of the colony.

I may perhaps explain at this point, that it is not the intention of the Association to develop cotton-growing by a system of large plantations. It is obvious that it is impossible to supply the huge quantities of cotton that are required by any such method. As soon as slavery was abolished in the United States cotton ceased to be grown in large plantations even there, and in Africa a system of native farmers on small plots is desirable if such a system is feasible. This suggested large plantation in Southern Nigeria must be regarded rather as an object-lesson and a technical school than the beginning of an attempt to supply by this method the deficiency from which we suffer.

I now come to the last, but by no means the least, of the British possessions in which there is great expectation of an increased yield of cotton. I allude to Northern Nigeria, of which Lady Lugard gave us such a graphic account three weeks ago. It is not too much to say that our greatest asset there is the Governor, Sir Frederick Lugard, who has shown such a splendid combination of energy and pluck, of patience and endurance, of firmness and fairmindedness in that country, qualities which have quickly achieved a remarkable success.

Northern Nigeria has a territory of 320,000 square miles, and a population of perhaps 10,000,000. That population is much less than it was, and much less than the country will support, and is composed principally of Haussas, the most intelligent and among the most civilised of the inhabitants of West Africa. By nature, peaceful and industrious, by inclination, keen and businesslike, it is impossible to over-estimate the commercial possibilities of this interesting race. As regards cotton it is indigenous in the country, and has been cultivated and manufactured there for a thousand years or more. It is a long way, however, from any part of Northern Nigeria to the coast, and the first imperative necessity is the building of a railway into the interior and the making of roads. A light railway can be built from a suitable place on the Niger to Kano for from half-a-million to a million pounds, and seeing that the British taxpayer is already paying a subvention of £400,000 per annum, it is surely worth while to advance a little more to develop the country, and it will, probably, quickly pay for itself. If no railway is built, it is impossible to carry cotton down to the Niger at a rate which would leave any reward to the cultivator at all, and it will be useless to expect any large increase of trade with the interior. If a broad gauge railway is attempted it will take many years to build and cost millions of money. A light railway can be quickly constructed, and would soon test, in a practical way, the commercial possibilities of the country. I do earnestly hope that a light railway will be commenced without further delay.

The possibilities of British Africa have now been briefly touched upon, and the time has come when I may sum up the general considerations which arise from the work already done by the British Cotton-Growing Association.

In the first place, it is proved that there is a vast territory in many different portions of our possessions where cotton can be successfully grown.

Secondly, whilst it is too soon to be certain in which of these possessions suitable cotton can be grown at a price to compete with the American and Egyptian supplies on which we now depend, there is every reason to suppose that when the Suakim-Berber and the Shiré-Nyasa railways are completed, cotton can be grown cheaply enough in the Soudan and British Central Africa to make it a commercial success, and there are strong hopes that this may be done in other parts of the Empire.

Thirdly, the chief difficulties in the way are labour, transport, and fluctuations of price. As to labour, it is a very doubtful policy to draft native labour from British Central Africa (where 12,000 acres are said to be already under cotton, and where labour is always short in the wet season) to the mines of South Africa. But there, as elsewhere, labour difficulties can only be met by patience and by just and reasonable treatment of all who can be induced to work. As to transport, our Governments must be more ready than they have been in the past, to make railways and roads where necessary. As to fluctuations of price, the British Cotton-Growing Association must minimise the effect to the native as much as possible.

Fourthly, it is obvious that the increased

growth of cotton in Africa will be best achieved in the long run, not by native labour in large plantations, but by native farmers. No system of large plantations can possibly meet the case nearly so well as a system of small farms cultivated by native owners. The problem is vast and, if the native can be induced to undertake cotton culture on his own account, his interest will be stimulated much more than it can be by an offer of wages. I am aware this is a disputable point, and I ought not to treat it dogmatically. Africa is large and one type of native varies from another much more than one European from another. Fortunately the native African is for the most part a born trader and, in many cases, willing to work if he is sure of a satisfactory market for his produce.

This brings me to the last consideration I desire to put before you. This is not the first occasion on which an earnest effort has been made to lessen our dependence on America for the greater part of our supply of cotton.

In 1850 the Manchester Chamber of Commerce deplored "the continued dependence of the great industry of this district for the supply of its raw material, mainly from a single source," and in 1857 the Cotton Supply Association was formed, a most active and vigorous organisation, which worked hard for many years to increase the supply of Lancashire's chief requisite. The Association had the support of the Press, and the *Times*, in blessing it, praised the practical enterprise of its promoters, and seized the opportunity, not for the first or last time, of indulging in a gibe at the Manchester economists, who were supposed to be lukewarm to the movement. This Cotton-Growing Association was more cosmopolitan in its scheme of operations, more philanthropic in aim than the present effort, for it was partly directed against the slave-grown cotton of the States. But the British Empire was then smaller, and that was an age when cosmopolitanism was popular, and when business men combined altruism and commerce. I do not mean that the Association neglected the Empire. It bombarded the India Office with memorials and a great effort was made in East India with most happy results, during the time the American War lasted.

A noble attempt was made in the West Indies. I hold in my hand a letter from Mr. Stephen Bourne, of the Jamaica Cotton Co., Limited (patron, Lord Brougham) which states that the Sergeant-at-Arms had kindly allowed a bag of cotton grown on the estates of the company to be on view in the House of Commons. The letter concludes, "I think there can now be no reason to doubt our entire success."

Besides the East and West Indies, Australia received much attention. A Commissioner was appointed to promote emigration, and the Queensland Government offered a bonus of £10 a bale on Sea Island cotton, and £5 a bale for other descriptions.

The Cape of Good Hope, Natal, and other of our possessions are also mentioned in the record of the Association's work.

The hopes of the pioneers of the movement seem to have centred almost as much on Turkey (European and Asiatic), Egypt, Italy and Greece, the Brazils, and other parts of Central and South America as on the Empire. Serious efforts were made in Turkey, and an address was presented to the Sultan at Buckingham Palace in July, 1867, in which the Association states that it "has observed with admiration the wisdom shown by your Majesty in the selection of judicious officers to carry into effect the measures devised for extending the growth of cotton, and has never failed to appreciate highly the value of those measures." Unfortunately, all officers were not judicious, and all measures were not effective, and, as does sometimes happen even in Turkey "express promises" remained unfulfilled. Machinery, imported duty free, could not be erected up country, for want of authority from Constantinople. A tax-collector's impositions led to the suspension of operations in one district; the crop could not be gathered at the right time in another, because the farmer of tithes had not visited it; and the sacred custom of *Bozook*, which allows cattle to roam at large and devastate growing crops was so deeply rooted, that the constant orders of the Governors-General to abolish it were disregarded. In addition to all this, there was an export duty of 5 per cent. to 15 per cent. You will not be surprised to hear that the efforts of the Association in Turkey did not meet with permanent success.

It is unnecessary for me to describe their operations in other parts of the world. I may briefly sum up the results of this earlier effort. It would be a mistake to suppose that the work of the old Association was in any sense thrown away. There were some successes; there were many failures. The growth of cotton in Egypt, India, and Brazil has increased since their day, and they may claim some of the credit for

at increase; but of these three, Egyptian is only kind we now use largely. The West dian experiments appear to have failed at at time because the crop was a precarious e, and because the cultivation of sugar was more remunerative.

In West Africa, the trade seems to have dened in later years through the low price of nerican cotton, and through a lack of cheap ans of transport. In East Africa no serious ort was made, again because of the absence transport facilities.

The great difference between now and then that in the Soudan, Uganda, and British ist Africa, British Central Africa, and geria, we have to-day vast areas capable of owing cotton to all appearance as well as y other part of the world. None of these ritories belonged to us, or were under our otection, forty years ago. Again, in the est Indies, economic conditions are more vourable to the growth of cotton than they re, and there is a field for experiment in irma.

In spite, therefore, of the partial failures of past, the new movement may be said to ve every reasonable prospect of success. We all waste no more time or trouble now on Sultan of Turkey. On the other hand, the st hopeful fields of the future are new possions or protectorates of the Empire, which ild not have been exploited before, because lack of transport facilities. We have got yond the old ideas of *laissez-faire* run mad, ich argued that it was never the business of Government to make a railway which private lividuals would not undertake. All this is to good, and a sound combination of private erprise and Government assistance should ry us far on the road to achieve the ends we ve in view.

That there are great difficulties to surmount, one will deny; that progress may be slower n some ardent souls desire is probable; we must never forget the urgency of our ds, and we must not lose sight of the coneration that the Soudan and British Central ica, and Nigeria, have each sufficient terriy to grow, and a soil and climate suitable growing millions of bales of cotton every ir.

n conclusion, I have only to thank you for patience and attention with which you have ened to a paper full of rather dry detail, l to ask you to continue to take an interest what may be called, without exaggeration, great Imperial movement.

DISCUSSION.

The CHAIRMAN thought the paper had been one of the greatest interest and of permanent value. No one could underrate the importance of the subject. This country depended on plentiful and cheap supplies of food, coal, iron, and cotton. He noticed a very remarkable omission from the paper, an unusual one nowadays when any trade question was being discussed, namely, that there was no mention of tariff reform. He did not mean to say by any means that that subject was out of order, but he did not suppose that anybody imagined that the first step towards encouraging the growth of cotton would be to impose a duty on the raw material, from wherever it came. The country naturally wanted to stimulate the growth of cotton, and the author could not have emphasised too strongly the great danger there was of the demand for raw cotton outrunning the supply, and the recurring danger of an oscillation of price, for which he pointed out quite rightly that the remedy was to increase the supply. The case for adding to the amount of the raw cotton crops of the world was proved, and the urgency of it was also proved. He agreed entirely with the author that it must be done by creating new sources of supply, and, as far as they were concerned, within the British Empire. He had not the least doubt that natural forces left to themselves would very greatly increase the areas which now produced cotton, but he agreed with the author that they ought not to depend upon the slow action of natural forces. Before they had afforded an increased supply there might have been a very ugly "squeeze," which might have left England without either a population or capital to take advantage of the increased supply when it became available. They were in presence of a very real danger; and he thought the author in his paper more than hinted that those who were most interested in the cotton industries had been a little backward in realising how serious that danger might be. But they had realised it now, and if that was so, perhaps after all Mr. Sully, whose name had not been popular in Lancashire lately, might turn out to have been a blessing in disguise, to everyone except himself, if he had helped them to realise that strenuous efforts were needed to increase the supply of raw cotton. The difficulties would be mainly those of labour and means of communication. He was very glad to hear the author's opinion that for the growth of raw material a peasant proprietary or tenant peasant farmers were needed, because he thought that tended to simplify the labour difficulty; and as he gathered cotton must be grown mainly in tropical areas, even if they had to import labour, the same controversies would not arise which arose when labour was imported into some other parts of the world. They were told that a perennial supply of labour could be brought from China. If it was imported from China into a tropical country he did not know that the same controversy would arise which had arisen in a

recent case in regard to importing Chinese labour elsewhere. But personally he should always prefer, assuming it was necessary to import labour (which he did not gather was proved in the case of cotton, because there was a large population in Africa already which was very well suited to growing cotton) to first of all look to parts of our own Empire, such as India, for its supply. With regard to means of communication he gathered that if railways and roads could be developed so as to bring the cotton-growing areas within reach of the coast, the sea means of communication would probably look after themselves. He understood that the choice of areas to be developed for cotton growing was almost embarrassing, and the British Cotton-Growing Association was, no doubt quite rightly, spreading its experiments over a very wide field, but if they intended to press the Colonial Office for assistance in regard to the building of railways it would be desirable not to press them too much, because Governments when they were pressed too much were apt to become first puzzled and then obstinate – but to concentrate their efforts upon pressing the Colonial Office to assist the railways in certain definite places. He thought something should be done; and that some choice should be made upon which the Colonial Office should be pressed specially to concentrate its energies. What was really needed was advice as to what areas should be developed and how they could best be developed; and there were several gentlemen present who could give that information.

Sir Harry H. Johnston, G.C.M.G., K.C.B., said he could add a little information respecting the districts of Africa which the reader of the paper singled out as being possibly suited to the cultivation of cotton. With other gentlemen he had recently been instrumental in sending out to the little negro republic of Liberia an eminent botanist, Mr. Alexander Whyte, to examine into the interesting flora of Liberia; and amongst other discoveries that gentleman thought he had lighted upon was the important one of cotton, showing a long staple. It might or might not be a development of the wild *Gossypium anomalum*, which seemed to be the only truly wild species of the cotton tribe in the continent indigenous to Africa, or it might be like the coffee of Liberia, a new species peculiar to that remarkable little region, which had so much that was strange and confined to itself in its fauna and flora. The specimens had not yet arrived, but they were now on their way to Kew, and he hoped they might reveal a fresh ground on which cotton of valuable quality could be cultivated with great success close to the sea. In reviewing the various parts of Africa to which their energies should be devoted in the matter of cotton cultivation, he thought they should endeavour to be practical, and to select in preference the coast regions first if they were suited in climate, soil, and labouring population for the cultivation of cotton. Undoubtedly, Northern Nigeria might be a magnificent field for co[n] cultivation. Much of the soil was what would[e] called in India cotton soil, but as it was far a[w]ay from the Niger and Benue it meant that the m[eans] of transport were absolutely deficient. Even [the] Niger and the Benue near the cotton-grow[ing] regions were obstructed by rapids, and were n[avi]gable only during a very short period of the y[ear]. He wished to say how thoroughly he agreed with [the] author in enunciating the principle that so far [as] possible they should grow cotton in Africa [in] partnership with the African, and should [not] attempt, unless it was absolutely necessary, [to] import foreign labourers if the business could [be] done by the African himself, under slight tuition [at] the hands of the European. The most impor[tant] point of all was the means of communication wh[ich] would make it possible to grow cotton at a profi[t in] various parts of Africa. Undoubtedly, light railw[ays] were required to open up many regions which we[re] close to navigable rivers or to the coast; but he co[uld] not help feeling that in regard to the matter of co[tton] cultivation as an imperial question, and of other q[ues]tions equally important and equally imperial, t[hey] had not sufficiently enlarged the home machiner[y to] deal effectively and economically with those questi[ons]. He would try to speak guardedly to avoid giv[ing] undue offence, but there were sometimes occasion[s i]n which they must grasp the nettle even if it hurt th[em]. What was the practical position in regard to oper[nin]g up the distant regions of the Empire by railw[ays] which were not under the great enlightened Gov[ern]ment of India, but practically managed from Downi[ng]-street? There was no definite system. A few y[ears] ago they went on the plan of handing over [the] matter to be dealt with by Crown Agents, who w[ere] the men of business at the Colonial Office. [He] could not say that the results that had come fr[om] Crown-agent-built or contracted-for railways [had] been altogether satisfactory, or even satisfact[ory]. They had built railways at an extravagant cost, [so] extravagant that it had really compelled even the m[ost] imperially-minded taxpayer to reflect on how m[uch] further he could go on the same road. For instan[ce], take the reports of Sir William MacGregor, and r[ead] his criticism on the way the railway was construc[ted] through Lagos; and also read the many complain[ts], not of mere cavillers but of responsible people [like] Sir Alfred Jones, of the way in which the railway [was] constructed to Ashantee. Take also the Ugan[da] railway. He was permitted to publish some vi[ews] and statistics on the subject; and he came to [the] conclusion that if that business had been done b[y a] firm, say, by contract, something like three-quart[ers] of a million pounds might have been saved [in] the construction, out of perhaps five millio[ns]. When one had the national purse to draw [on] and was not immediately responsible, one was [apt] to be much too large-minded as to expenditure; [and] when things were managed in that way all sorts [of] people were sent out, not because they were absolut[ely]

d for the work, and would be chosen by a hard-ed business firm, but because they were people n somebody wanted to provide for. It was ·rid" to have to say such things, but England rapidly out-running her credit, and yet wished to lop her empire more and more; and though it t hurt people's feelings in some quarters, ical politicians had to bear those facts in mind. posing that certain departments of the Govern- were a little disgusted with the present system, said, "When the next railway is made we will v it open to public tender." If a contractor he work he would have to do it in the teeth of opposition he would receive from the Crown its, because the Crown Agents must, as the ness men of the Government, superintend the ng of the railway, certify that it was up to the , and finally pass it as made according to the ract. He happened to be a director of a company h was making the railway that had been alluded rough Nyasaland, in British Central Africa, for, oped, the British Government. It was obvious im what the difficulties were if one tried to make lway in despite of the Crown Agents. They had engineers on the spot who had their ideas as to vay bridges should be constructed, and thought a bridge should cost £40,000, when the railway pany were perfectly well aware from Indian rience that it could be done for £20,000. Un-cicusly the Crown Agents' advisers were avouring to make railway-building in Africa as nsive as possible. Not having the national purse raw upon contractors were constantly face to face something like bankruptcy. He did not want present to think that he was constantly changing iews. There was a time when the cotton project not been brought up, and when coffee had been lure, and the British taxpayer was always paying money, when he thought that the able-bodied g men in those lands who were anxious to do and could not get it on the spot, might have to South Africa, have worked there for a year vo, and come back with wages to spend in their land; but it was obvious that a railway, or any r great enterprise, could not be constructed ply in a land from which the labour was now g drafted somewhere else. The matter must be into from a most businesslike point of view. y must either so enlarge their Government rtments, say the Crown Agents' Office, as to er these departments able to build railways as ply, as thoroughly, as satisfactorily as railways been built in India and other great depen-cies, or if they invited private enterprise to ertake the building of the lines, reasonable ouragement must be given to them to do so. ly, he thought they ought, as far as possible, pay for the railways constructed in money, and entirely in grants of land. He did not at agree with the principle of taking away large s of land from the possession of the natives of Africa, even though the land might be handed over to the most benevolent of landowners. He was con-vinced that England would not really do well in the part of Africa between the Zambezi and the White Nile, unless we worked in partnership with the natives.

The Hon. WILLIAM PEEL, M.P., said that he re-presented in Manchester a great many gentlemen who were suffering at the present time from the depredations of Mr. Sully, and he could assure the Chairman from personal knowledge that many artisans who were not philosophers did not regard Mr. Sully as a blessing, either disguised or un-disguised. The question of the supply of cotton was an immensely important one for Lancashire more so than for any other part of England, and was one of growing interest; because in most manufactures the tendency at present was for the article to be manu-factured more closely to the source of supply of the raw material. Therefore, if the sources of supply could not be enlarged in places where the article was not likely to be manufactured, a very great danger must overhang so important an industry as the manufacture of cotton in Lancashire. He wished to refer particularly to the fine cotton-spinning manufacture, because if the statistics were perused it would be found that the voracity of the spindle was far greater in America and other countries than in England: it was about 90 lbs. per spindle in America, 70 lbs. in Europe, and only about 34 lbs. in this country. Twenty years ago it used to be 36 lbs. per spindle in this country. An explanation of those figures lay in the fact that the fine cotton-spinning in this country was infinitely ahead of that in other countries. He had the advantage during the end of the winter in going round Germany for about six weeks look-ing into the question of manufactures in that country; and German manufacturers told him that while they thought Germany was ahead in all matters connected with chemical industries and iron, they admitted that in cotton-spinning England was far ahead of Germany. That had been often put down to the fact that the agreeable climate of Lancashire gave a dampness to the atmosphere which enabled very fine cotton threads to be drawn out to greater lengths more easily without splitting than in other atmo-spheres. The Germans had produced splendid imita-tions of nature by means of their synthetic processes, but he was told that up to now, in spite of their test tubes, they never had reached the right synthesis of cotton-spinning air. Cotton for the finer counts was taken from the Sea Islands off the coast of North America. That was a different supply to the cotton grown in America itself, and was a very small supply; and it was immensely important, with reference to that particular advantage which we possessed in this country, that the supply should, if possible, be developed. From the recent operations of the British Cotton-Growing Association there seemed

some hope that in the West Indies similar cotton might be produced. An interesting experiment was made recently by an enterprising lady in the island of Montserrat. She grew some cotton from Sea Island seed, and produced a very good long and silky staple, which was sold at about $11\frac{1}{2}$d. per pound, and cleared about £8 net profit per acre. If that could be done in one island he hoped it could be done in the others on a larger scale, and in that way an immense encouragement would be given to that important branch of cotton-spinning manufacture in Lancashire, which was not so much affected by Egyptian or American cotton, but depended upon a very small part of the world for the supply of its material. In travelling about Germany it would be found that, although by their tariffs and by their own manufacture, they supplied themselves with a constantly-increasing amount of the lower class of cotton goods, they still must have the special fine class of cotton goods, and thus our position in the German market depended on the risks of harvest in a very small area. With reference to what the Chairman said about labour, he touched very nearly on a dangerous controversial subject. Knowing something of the conditions in Northern and Southern Nigeria, the question of the supply of above-ground labour for cotton-growing in Africa was a very different one to the question of supplying labour for the mines. It was work for which the natives were very much more fitted; and he thought Sir M. Bhownaggree would agree with him that one could much more easily get a supply of natives from India for working cotton than for working in the mines; so that whether there were peasant proprietors, or labour was brought in from outside countries into Northern and Southern Nigeria, the difficulties would be infinitely less; and he hoped no controversial questions would arise in connection with it. If any criticisms had been levelled against Manchester for being backward in the matter he thought they no longer applied. Large sums of money were now being freely offered, and the interest taken in the matter was so intense that the only subject for discussion now was as to what part of the world, with the best profit, they could commence immediate operations.

Lord Reay, G.C.S.I., G.C.I.E., said the subject was of the utmost importance to the presidency with which he had had the honour of being connected. He held in his hand the most recent information obtained from the Agricultural Department of the Government of India, and its contents confirmed facts which were known, namely, that one could not expect to transform the short staple cotton which was grown on the black soil areas of Madras, Bombay, and the Central Provinces into the long staple cotton which was required in England. But, fortunately, they could prevent the degeneration of cotton which had been so detrimental to the extension of cultivation, and to the price which the cultivator could get; and he was glad to see from the pa[per] that the Government had awakened to their r[espon]sibility, and that experiments were being ma[de] artificial fertilisation to improve the short [staple] cotton. He was also pleased to see that the G[overn]ment Paper stated, although the language use[d was] careful—that "the Government Departmen[t] more sanguine regarding the adaptability of [the] varieties for the dryer portion," &c. He wa[s] glad to see from the paper that however de[sirable] it was to have the work done soon that it [should] be done by agricultural apprentices or t[he] field men who were fairly educated. That led [him,] not for the first time, to lay great stress on th[e im]portance in India of agricultural education. [The] importance of having the men whom the native [agri]culturist himself trusted properly educated coul[d not] be exaggerated. What was proposed in the [paper] was that after experiments had been made o[n] farms that encouragement should be given i[n] various districts, in a small farm of five acres, ca[lled] demonstrative farm, and bring under the not[ice of] the cultivator what he ought to do to impro[ve] crops. He could not say that that might not [have] been done sooner, but it was better late than [never,] and he was extremely pleased to see that now, [at all] events, the Government of India had thoro[ughly] awakened to the extreme importance of seeing [what] could be done to provide a long staple cotton [which] was required in England, and which he was sure [they] would all like to obtain for the great Indian Emp[ire.]

The Hon. Sir Horace Tozer, K.C.M.G., sa[id he] wished to state how far Australia or New G[uinea] could assist in supplying cotton for the Empire. [He] represented a portion of Australia and the wh[ole of] New Guinea. He also had the privilege of h[aving] lived in the district in which cotton was grown i[n the] sixties, and he was the Minister who gave a bon[us in] the nineties to encourage the growth of cotton i[n the] same district. In the sixties, when the Civil Wa[r was] in progress, Australia tried to supply a portion o[f the] cotton for the Empire, and grew between one [and] two million pounds. They demonstrated at [that] time that good cotton could be grown, and tha[t the] soil was suitable; and they also had all the [pro]visions for transport. But unfortunately at that [time] three circumstances happened. First of all, the [war] ended, and prices went down; secondly, the [gold] fields opened, which was a greater attraction; [and] thirdly, sugar plantations commenced, and the S[outh] Sea Island labour which was then being used [was] taken away for that purpose. That was the en[d of] the first experiment in the sixties, but it left no d[oubt] as to the suitability of the greater portion of Que[ens]land for the growth of cotton. In 1890, the Mini[ster] agreed to give a sum of £5,000 to any com[pany] which would produce ten thousand yards of co[tton] grown in the colony and manufactured by their [own] labour, and that sum was paid, proving that Aust[ralia] could grow cotton. But the industry died out in

way from the want of labour. Circumstances which satisfied the people that it was not wise ntinue the importation of black labour, and the quence was, that at the present moment very was being done; but he assured the audience iot only in Queensland itself, but in the northern ɔries of South Australia, there were millions of suitable for the growth of cotton. There were in most portions of Queensland, facilities for ɔort. He was delighted to inform those present the Prime Minister of the Commonwealth had nined that the most vigorous efforts should be for the purpose of seeing whether the growth of ı could not be stimulated in Queensland, and ·alia generally, by a white peasant proprietary. d not hold out the slightest hope that cotton l be grown by black labour, and that the colonies l reverse their white-Australia colony for that se. There was no doubt that there was an nse tract of country in New Guinea suitable e growing of cotton, but he did not think the r would be available; it would be some years the labour could be brought in. It was agri- al labour, but unfortunately it was in the s; and there were so many other avenues of yment in the world that there were not many e available at the present moment. He hoped ffort which the Commonwealth Government naking would bear fruit. Experiments were on in Australia, not only in the direction of g whether cotton could be grown to pay, but er it could be improved. A gentleman in the s district, had a large district under cotton, ad succeeded, after many experiments, in de- rating that he could grow a cotton tree of a nial character. The cotton was grown generally mall bush, but it was now grown upon a tree as an orange tree, which produced magnificent ı, for which he was offered ninepence and ten- a pound in Italy and England. If such an ment, which he had every reason to believe be successful, continued, there was nothing ver to prevent the development of cotton- ng by white labour. He wrote his Agent al's Report only last week, and he was stimu- not only his own State Government but the ıonwealth Government to treat the matter as ial.

GEORGE BIRDWOOD said he would confine lf in his observations to Mr. Emmott's three aphs, in p. 444, relating to Indian cotton, rpose being to justify the hope he had always hed of the great future there was for India not in the enlarged and improved cultivation of , but in the extended manufacture of cotton of all denominations, the highest and the , and practically for all the world. The English cotton was derived through the French *coton*, he Arabic *kuttun*. In Italian it was *cotone*, in German *kuttun*, in Dutch *kutzen*, in Spanish *algodon** [*cf.* the French *auqueton*, and English "acton," a coat quilted with cotton], and in Portuguese *algodno*. The Greek word *chiton* "a tunic," the equivalent of the Hebrew *kethoneth* [Josephus A. J. iii, vii, 2], is again the Arabic *kutun*. In Esther i, 6, the Hebrew word which in the A.V. of the English Bible is wrongly translated "green" is *karpas*, the Sanskrit *karpasa* cotton, and the Hindi *kapra* [cotton]—"clothes." It is transliterated by "The Seventy" *karpasinos*, *i.e.*, made of *karpasos*, and these words, and their Latin equivalents "carbasus," "carbasinus," and "carbaseus" were used by the Greeks and Romans, respectively, for "flax" in their substantival, and for "fine linen" in their adjectival forms. The *sindon* of the Greeks, in fact a fabric "of fine linen," is etymologically "Indian"—muslin. It is the *sindhu* of the Babylonian inscriptions, the *sadin* of Judges xiv, 12, and Isaiah iii, 23, the *shento* of the modern Egyptians, the "sendal" of Chaucer† and the *Vision of Piers Plowman*, and the "cendal" and "sendal" of modern English writers. The Greek word *othone* [St. John xix, 40, Acts x, 11] "a veil of fine linen" derived directly from the Hebrew *ethun* [Proverbs vii, 16], is possibly the Hindi word *otni*, carded cotton. Shut out from the Indian Ocean by the Isthmus of Suez the Greeks like the Romans were from the first users of flax [*linon* and *bussos* (Rev: St. John xix, 8, 14)] not cotton; but under *bussos* [Hebrew *butz*, Esther viii, 5, and *bud* Levit: vi, 10] they would appear to have sometimes included cotton, while under their denomination *linon lukon*, literally "white flax", they certainly included cotton.‡ But their

* The Anglo-Indian word "godown" used throughout the ports of Southern and Eastern Asia with the meaning of "warehouse," is of undetermined etymology, and may possibly refer to these warehouses having been originally used by the Portuguese and Spaniards as cotton stores.

† "Prologue C. T." 439-440, where of the "Doctor of Physik" it is sung:—"In sangwyn [scarlet] and in pers [light blue] he clad was Lyned with tafata [Persian *tafta* "woven", a plain silk] and sendal [here fine silk]." This ritual ought to be more carefully observed in the fashion of the robes of graduates in Medicine and Science."

‡ The confusion of cotton with linen continued in England down to the end of the 17th century; and the most interesting contemporary record of this extraordinary fact is to be found in Pepys's *Diary*, under date of 27 February, 1664:—"Great, good company at dinner, among others Sir Martin Noel, who told us the dispute between him, as farmer of the Additional Duty, and the East India Company, whether callicos be linnen or no, which he says it is, having been ever esteemed so: they say it is made of cotton woole, and grows upon trees, not like flax or hempe. But it was carried against the Company, though they stand out against the verdict." Cotton did not become the staple of England before the 19th century; and by the middle of the century "the Manchester" interest dominated all other interests in the United Kingdom, and in 1846 secured the repeal of the Corn Laws, that is, in effect, the destruction in the end of all other interests centred in the soil and the peasantry of the United Kingdom.

authentic word for cotton was *xulon*, literally "cut wood" [*cf:* Herodotus iii, 47, and vii, 65]. Pliny calls the cotton plant "gossypinus" [xii, 11, (21), and German *baumwolle*], a word of unknown Oriental origin; and again "gossypium", and "xylon", and the tissues manufactured of cotton "xylinia" [xix, 1 (2), see also vi, 17 (20), vii, 1 (2), xiv, 2 (4), and xvii, 24 (36)], The Latin word "bombyx," represented by the Italian *bombagia*, and the English words "bombast" and "bombazine," as applied alike to cotton and cotton stuffs, and silk and silk stuffs, is directly derived from the Greek *bombux* [*cf.*: *bombax*, "bombast," and *bombos* "a humming," "a buzzing"], meaning the "silk-worm," and "silk" only. But as the Greek *bombux* is probably a corruption of the Hindustani *bandak*, *i.e.*, "carded cotton," the seemingly ambiguous use by the Romans of the word "bombyx," and by ourselves of the words "bombast," "bombazine" is etymologically justified. Pliny applies the term "bombycinus" exclusively to silken stuffs [xi, 22 (26)]. The term "calico" ["Callaga," "Calicut," &c.] applied to cotton cloth, dates only from the first importations into Western Europe of the fine productions of the looms of Southern India [Madura] from Calicut, after the Portuguese discovery of the ocean highway to India round the Cape of Good Hope. These etymologies of themselves indicate, what the history of the cotton industry demonstrates, that the name and fame of Indian cotton, and cotton fabrics,—names transferred northward and westward to flax and linens,—were more or less known to the whole civilised world of antiquity, *i.e.* Babylonia, Assyria, Greece, and Rome; and we now know that the cultivation and manufacture of Indian cotton had, at an undetermined period of antiquity, established themselves in Egypt, and by the 8th century B.C., in China [where they took seven centuries to pass over into Japan], and that step by step, across the wide waters of the polynesian Pacific Ocean, they at last, at an unascertained date, anterior to the 10th century A.D., became naturalised in Peru, where they reached their zenith in the 14th century, or about 200 years before the discovery of America, by Columbus. But while the cotton plant, and cotton wool, and cotton cloth were known to the Greeks and Romans, if only by reputation, it was the Arabs who first introduced the field cultivation of the plant, and the manufacture of its wool, into the European countries of the Mediterranean Sea. They energetically took up, under the guidance probably of individual Greeks, and very much after the manner of the Japanese of to-day, all the scientific work of classical antiquity initiated by Greece and Rome, holding up the newly-lighted torch of Western scientific culture through all the chaos and darkness following the decline and fall of the Western Roman Empire;—marked intellectually by the suppression of the schools of science [Theodosius II.] at Alexandria, A.D. 414, and of the schools of philosophy [Justinian] at Athens, A.D. 529. The Arabs practically supplanted the use of linen for clothing in Sou[thern] Europe by that of cotton: and Sætabis, now X[ativa], the great centre in Spain for the supply of [linen], with linen was driven to use flax for the manufa[cture] of paper, previously made by the expensive [pro]cess of slicing the pith of the papyrus stem [into] long strips, and joining these together into a [con]tinuous roll. The Arabs also used cotton for ma[king] the new paper, which gradually drove out both [the pa]payrus and the parchment roll,—and prepared [the] way for the printing of books of the comparat[ively] cheap and handy form still in use throughout [the] whole civilised world. The universal adoption [of] the Arabic designation of cotton marks [the] revolution thus gradually effected in the te[xtile] industry of the south of Europe; and the [...] dominated all others until the second great, and [...] abiding, impetus to the wearing of comparat[ively] cheap cotton clothing consequent on Da Ga[ma's] heroical adventure, gave an almost equal vogue to [the] word callico. Already in 1610 Drayton could w[rite] in *England's Heroical Epistles*, "*Edward* the fo[urth] to *Shore's* wife":—

> "If thou but please to walk into the Pawne,
> To buy thee Cambrick, Callico, or Lawne,
> If thou the whitenesse of the same woulds't proue,
> From thy more whiter hand pluck off thy gloue."

Again although the so-called species of "wo[ol] bearing cotton plants have been multiplied [by] hair-splitting botanists to ten or a dozen, [more] careful discriminators between species have [re]duced them to four, *Gossypium herbaceum* [*i[ndi]cum*] and *G: arboreum* [*religiosum?*] the In[dian] so called species, *G: vitifolium* [*barbdense* and *rel[igi]osum?*] the "Sea Island Cotton plant"; and *G: a[cu]minatum* [*peruvianum, religiosum?*] the "Peru[vian] and Brazilian" cotton plant. But Sir Jos[eph] Hooker refers both the Indian so called spe[cies] of cotton plant to *G: Stocksii* as the pa[rent] type of all the Indian varieties of cot[ton] plants; and the late Dr. Charles Pickering, [...] the author of *The Races of Man and their G[eo]graphical Distribution*, and "The Geograph[ical] Distribution of Animals and Plants" [Vol. xv. [of] the publications of United States Exploring Exp[edi]tion under Captain Wilkes of the *Vincennes*] st[ates] that the Sea Island cotton plant was introduced i[nto] North America by European colonists, from the E[ast], where another variety of it has been developed [in] Egypt; and the so-called species of *Gossypi[um]* yielding Peruvian cotton, is found also in Assam [and] Burmah, and in Spain and China;—and taking all th[e] circumstances into consideration, and the fact that [the] history of the cotton trade traces it back to Indi[a as] the centre from which it has spread over the wh[ole] world, the inference is that there is only one nat[ural] species of cotton plant, the Indian species *G. Stock[sii]* and that all the other so-called species are variet[ies] developed, either naturally under local variations [of] soil, temperature, and humidity, or artificially un[der] cultivation in India, and other tropical, and s[...]

cal, and even temperate countries. There, herefore, no reason to despair of India as a ;e of supply for the spinners of Lancashire. it in his opinion was needed to give the export ıdian cotton to Lancashire and to Europe a t impetus was, to encourage the special cultiva- of it, in specially selected districts and soils, e it has already reached its highest development, is measured by the standard of the requirements ancashire and Europe. The native cultivators of ı grow cotton of every variety of staple, in every ty of soil, in every part of India,—whether suit- or unsuitable for the demands of Lancashire and ›pe. And they are quite right in so doing. The demand for cottons of various staples, especially shorter, is ubiquitous and insatiable; and the ;, therefore, cannot be expected, unless very ıg inducements are offered them, to dis- inate in favour of a special district, and ial soils, and special treatment for their ɔn crops for the benefit of virtuously indignant ;ashire. But the demand for Indian cotton his country is not altogether kept down by ıferiority of staple, but in some part also by the condition in which it is shipped to Europe. ng India generally, the cotton crop is for the part ingathered during the month Vaisakh ril-May]. Some great festivals have to be held ıg this period, and whenever they begin the ɔing of the cotton is at once suspended until they ; and the rapidly ripening and bursting bolls o the ground, where they are blown about all n the dust, and are saturated with dew all night, become ingrained with grit, and discoloured by soil, and utterly unfit for the use of Lancashire. yet this cotton is acceptable to (1) the paid sters, (2) the paid cleaners, (3) the spinners and ers,—who all profit by the dirt in the cotton— 4), wonderful to say, even to the consumers. No rnment, least of all an alien one, can interfere in a matter. But our English merchants could) with every prospect of success if they would come to a personal understanding with the ators, through their *gurus*, to regard it as e highest religious obligation, when once the hering of a crop — [and wheat as well as n]—had begun, to continue it to its completion. thing also, he was convinced would be gained ıking up the Indian cotton bales intended for t, of the same weight, measurements, and al appearance as the standard bales of Sea l cotton; and this could easily be done at the n pressing mills. So far as the inherent plasticity e Indian cotton plant, and the suitability of the n cotton soils, are concerned, the development of aple is quite possible, and he might say easy, ı certain selected districts, and in certain ed soils, and under a similar system of cultiva- to that which has given Sea Island cotton the ıand of the Lancashire market. Some Indian ıs attain, even under the traditional modes of cultivating them, a staple of one inch. In colour, they are all, as they burst in the bolls, superior to Sea Island cotton, both softer and warmer toned to the eye; while in strength they are also all superior to Sea Island cotton. There is a cotton grown in Tirhut, and gathered in the month Bhadrapada [August–September], of a beautiful buff colour—a ruddy buff — and so durable, that a vesture made of it lasts a lifetime, although washed every day! The adventures he suggested, he would begin in the Dacca districts, in the delta of the Godavery, and in the Berars. The whole problem was to start the growth of a longer staple. But Lancashire must not call upon the Government of India to do this, but put her own shoulder to the wheel,—"*fara di sè*" as the Italians say of Italy. We have absolutely nothing to teach the people of India in the way of the improved cultivation of cotton so far as their own interests and happiness are concerned. Through 3,000 years, by patiently assimilating themselves to their soil, and perseveringly adapting their soil to their own needs and necessities, they have perfected their vernacular system of agriculture; and it would be the meanest treason against humanity, and a damning blunder, to interfere with it, by the *force majeure* of the State, and throw it all into confusion—as we have done with the artistic and religious culture of India,—to promote the sordid interests of Lancashire. But great things, and for the lasting good of both India and the United Kingdom, and the Empire as a whole, might be achieved by the co-operation on equal terms of our English merchants and manufacturers, with the merchants and cultivators of India. India presents the most extended area of the most fertile tropical soils, some of it specially adapted to cotton, on the whole surface of the globe, and gives habitation to about 300,000,000 of the most hardy, temperate, industrious, simple, docile, and loyal people of all the races of mankind; and all expert specialists—by 3,000 years local training—in agriculture, especially cotton agriculture. This is the reproductive force of India; largely latent possibly, regarded from the point of view of Lancashire, but when fully nascent, capable, under the intelligent and sympathetic guidance of Lancashire, of supplying not only Lancashire, but the whole Empire, with the raw materials for all their manufactures. But it is a sacrosanct system which has for 3,000 years "engineered" this economic force, a system of which we know nothing, and which we must handle with caution, and something of devout humility. How the life and very soul of the people of India is steeped in their agriculture will be brought home to many of you for the first time possibly by the fact that they have over one hundred popular proverbs on the subject of cotton. He would conclude by repeating two. Of a miser they say:—"He has 12 *begahs* of cotton yet will not afford himself a girdle string": and of a disappointed man,—and this may have a personal application here this afternoon:—"He is like the parrot which waited for the ripening of the cotton pod,"—to find it a choking fluff ball.

Sir M. M. Bhownaggree, K.C.I.E., M.P., thought the author, in his extremely comprehensive and clearly-written paper, had directed public attention to a subject which was of great interest at present, not only in the United Kingdom, but throughout the British Empire. With regard to India, he had maintained for a long time that the great drawback to the proper development of the scientific growth of cotton was the want of a systematised education in its cultivation. He was very pleased that the higher authority of Lord Reay had gone before his to indicate that great drawback. He also thought the present action of the Government of India was extremely laudable, although he regretted it had been so tardy, and he trusted that before many years were over they would strive to make headway against the delay that had existed for many decades past in bringing a proper practical education in the cultivation of cotton to bear upon the people of India. They constantly heard of Government departments calling in the help of scientific people of great attainments for the purpose of making improvements. Those gentlemen sometimes made the improvements, but to whom did they appeal ?—not to the cultivator. There was only a clerical staff between them and the ryot, who became no wiser by the experiments. What was missed was the intervention of some of the educated young men of India, who should be the medium between the ryot and the Government officials. If a man was educated up to realising what the official of great attainments meant, the teaching would be effectual. The ryot generally was an intelligent human being, but he was not furnished with that root education which was necessary for the comprehension of such lessons as the experiments of the Government officials were meant to convey to him. If the educated men be drawn to this work they would be efficient agents for the instruction of the cultivator. Thus, instruction in the methods of cultivation ought to be more systematised, and put upon a different basis to what it had been up to the present. In the paper and discussion copious reference had been made to the importation of labour from India into other regions under the jurisdiction of the British Crown where cotton could be grown. He welcomed the idea of exporting the superfluous population of India for such a purpose, and thought the British Cotton-Growing Association, if not in its corporate capacity, certainly through the medium of the influential individuals which constituted that Association, could do a good deal to bring home to the minds of the authorities that unless they did something to have the British-Indian citizen treated like an ordinary human being in our Colonies, that it was vain to hope for the requisite number of Indian emigrants to go to those fields of labour. Another lesson which the individual members of the Association could also, perhaps, convey with good effect to the authorities was the necessity of removing such injustices as the Excise duty upon the cotton manufacture of India. As long as this monst[s] duty was allowed to be tolerated with equanin[,] although the ryot might grow his cotton, they [v] feel sure that there was a middle educated clas[s o]f great influence rising up in the country which wo[uld] prevent, if possible, the growth of such cotton [a]s was demanded by the needs of Lancashire, if L[an]cashire persisted in procuring the injustice that [ha]d rankled in the minds of the people of India fo[r] long.

The Hon. M. White Ridley, M.P., wished [t]o direct attention to two points, firstly, the very g[rea]t debt which all present owed to Mr. Emmott [fo]r bringing to a focus the considerable number of po[ints] which had been met with in various quarters, ther[eb]y showing that the community interested in cotton [ha]d reached a very large measure of agreement as to [th]e general situation, and as to the direction in which [th]e question of the growth of cotton should move if so[me] relief was to be found. Secondly, there was [a]n nearly an equal consensus of opinion that the priv[ate] efforts of the British Cotton-Growing Associat[ion] needed to be supplemented, and that the en[ter]prise of individuals was not likely to pr[ove] sufficient to meet the situation. The districts wh[ere] they might look for most advance in [the] development of the growth of cotton, w[ere] districts where, either in the past or in [the] present, there was considerable prospect of obta[in]ing assistance from the State in one form [or] another. Egypt, Nigeria, and other Crown colon[ies] were all districts where the principle of allowing [the] State to have some share in the development of [the] country had been to some extent allowed; and if [he] might venture to trench even more nearly upon [a] controversial topic he could not help drawing attent[ion] to the fact that that was really, to a certain extent[, a] reversal of the old colonial policy, which it would [be] admitted had its good feature as it also had its b[ad] features. He thought it was a matter of considera[ble] omen that there should be upon an important qu[es]tion such a large consensus of opinion that there w[ere] certain features in the old colonial policy wo[rth] considering.

Mr. Emmott, in reply, thanked the various gent[le]men who had spoken for the kind remarks they h[ad] made about the paper; if he had done anything [to] focus the question he was rewarded for the troub[le] he had taken. The audience would understand ho[w] difficult it was for him to keep on the main line, a[nd] not run off on to sidings, when they considered t[he] large number of serious questions that had be[en] raised which went right down to the root of Engli[sh] government in India, and some of the most diffic[ult] colonial questions that were at present before the[m]. That being the case, it was impossible for him [to] reply in the ordinary sense to many of the question[s]. He was particularly glad to hear that the[re] was some chance of Queensland growing cotton wi[th]

aid of white labour; that was the only way in 1 they could hope or expect that Queensland d do anything in the matter. He had also been cularly interested to hear so much hope expressed hose who knew India well that that country it still do something in the way of growing cotton better type from exotic seed. In conclusion, he ed to express his personal obligations to Sir ard Grey for presiding.

1 the motion of the CHAIRMAN a cordial vote of ks was passed to Mr. Emmott for his valuable r.

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r. JOSEPH RIPPON, as a representative of the t Indies, writes :—

ie Chairman mentioned that best results would w peasant proprietorship; but in tropical countries, sely inhabited, say British Guiana, what could be r than to induce East Indians, for whom we occasionally to raise Mansion House Funds, and se sufferings are so great, to emigrate to a place e they could and do live happily? It seems to questionable if cotton would have been grown to an extent if labour had not been brought into Jnited States. Another point. It did not seem known to some of the speakers that the Sea ld staple, only suited to our fine counts, is nically known as *Gossypium Barbadense*, and is genous to that island, and that it was from this that the long-stapled Egyptian and several other ties have been produced. *Gossypium Barba-e*, taken from Barbados, is also stated to be now isively cultivated along the coasts of South lina and Florida; and although the cultivation tton in the West Indies fell away to give place igar, it seems, from a West Indian point of view, the industry could now be best revived there, the large tracts of land in the various islands and he mainland of British Guiana and Honduras economically adopted, as at some of the places, as Barbados, where, I am told, 4,000 acres have, since the benefactor appeared in the shape Ir. Sully, been put under cotton cultivation in island. British Guiana has already suitable igements for the transport of labour from a to that colony, so that it would appear that ything is ready for work, except the initiative and rts from other cotton-growing countries, perhaps h Carolina and Florida, so that the experimental e might be curtailed. A recent report on a ole of cotton grown in British Guiana from ptian seed, said that it was one of the best results , well worth 9½d. per pound, and should be en-aged, and cultivation on a large scale carried out.

r. J. D. REES, C.I.E., writes :—In the discussion Ir. Emmott's paper, no attention was called to iarm done to the reputation of Indian cotton by packing, and the large amount of dirt generally d in the bales. For the rest, I think the super-is population of India, available for emigration, is largely exaggerated, and that the methods of cultivation of the Indian ryot are unduly depreciated. As one who voted for the imposition of the countervailing Indian cotton duties on Lord Elgin's council, I should have been glad to hear how members of that council would have been situated in respect of the Bill, had Free Trade not been accepted as the final and unalterable policy of England, to which all her dependencies necessarily had to conform.

MR. FRANCIS WILLIAM FOX sends the following extract from a letter on cotton-growing in the Egyptian Soudan, written to him in 1891 by the late Sir Samuel Baker :—

"The wealth of a country must depend upon its natural producing power, either by the fertility of its soil or by its manufactures. The Soudan depends upon its soil and climate.

"When the British forces advanced under Lord Wolseley to Khartoum, they passed through deserts only. The map will explain that they were never near the fertile provinces. These lie to the south and east of the river Atbara, including all the Nile tributaries of Abyssinia, and the Blue Nile.

"It must be remembered that the Atbara river is the actual parent of Egypt, having brought down the mud from the fertile table lands of the East Soudan to form the delta. This action is still at work, silting up the northern coasts of Egypt in the Mediterranean.

"The cotton plant is indigenous throughout the fertile provinces; it was mentioned by Pliny as the 'Wool-bearing tree of Ethiopia.' A three months' regular rainfall, including June, July, and August to the middle of September, renders that portion of the Soudan independent of artificial irrigation.

"At the time when the cotton crop ripens, there is neither dew nor rain. Therefore, everything is in favour of the gathering and storing—but it would be impossible to transport a tenth part of the cotton with the present limited means by camels, as was proved by Moomtazz Pasha when Governor of the Soudan.

"That enterprising Governor (in 1871) made the cultivation of cotton compulsory for one season, at a certain ratio of acreage in proportion to the population. This was a test of the producing power. In seven months, so vast a quantity was grown that it was impossible to carry it, and the greater portion rotted on the ground."

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock :—

APRIL 13.—"Agricultural Education." By J. C. MEDD. LORD MONTEAGLE, K.P., will preside.

APRIL 20.—"Motor Cars for popular use." By MERVYN O'GORMAN, M.Inst.E.E. The Hon. JOHN DOUGLAS SCOTT MONTAGU, M.P., will preside.

APRIL 27.—"The Need of Duty-Free Spirit." By THOMAS TYRER.

Dates to be hereafter announced:

"Lessons to be Learnt from the Fire Brigade Appliances at the late International Fire Exhibition." By EDWIN O. SACHS.

"Early Painting in Miniature." By RICHARD R. HOLMES, C.V.O.

"Statistics of the World's Iron and Steel Industries." By WILLIAM POLLARD DIGBY.

INDIAN SECTION.

Afternoons, at 4.30 o'clock:—

THURSDAY, MAY 12.—"British-Grown Tea." By A. G. STANTON.

TUESDAY, MAY 31.—"The Economic and Industrial Progress and Condition of India." By J. E. O'CONOR, C.I.E., late Director-General of Statistics, India.

COLONIAL SECTION.

Tuesday afternoons, at 4.30 o'clock:—

APRIL 12.—"The Regeneration of South Africa." By BEN. H. MORGAN. The EARL GREY will preside.

MAY 3.—"Canada and Great Britain." By W. L. GRIFFITH.

APPLIED ART SECTION.

Tuesdays, 8 o'clock:—

APRIL 19.—"The Sentiment of Decoration." By ALFRED EAST, A.R.A. ASTON WEBB, R.A., P.R.I.B.A., will preside.

MAY 10.—"Crystalline Glazes and their Application to the Decoration of Pottery." By WILLIAM BURTON. HENRY H. S. CUNYNGHAME, C.B., will preside.

MAY 17.—"Pewter." By LASENBY LIBERTY. SIR GEORGE BIRDWOOD, K.C.I.E., C.S.I., will preside.

CANTOR LECTURES.

The following course will be delivered on Monday afternoons at 4.30 o'clock:—

PROF. R. LANGTON DOUGLAS, M.A., "The Majolica and Glazed Earthenware of Tuscany." Three Lectures.

April 25, May 2, 9.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, APRIL 11...Royal Institution, Albemarle-street, W., 5 p.m. General Monthly Meeting.

Engineers, in the Theatre of the United Service Institution, Whitehall, S.W., $7\frac{1}{2}$ p.m. Mr. H. C. H. Shenton, "The Latest Practice in Sewage Disposal."

Chemical Industry (London Section), Burlington-house, W., 8 p.m. 1. Mr. W. Thomason, "The Volatilisation of Lead Oxide from Lead Glazes into the Atmosphere of a China Glost Sagga[r] [a]n[d] its effect upon the Leadless Glaze Ware [in t]h[e] same Saggar." 2. Mr. W. A. Thomason, "Th[e] Preparation of Lead Glazes of Low Solubility, [a]n[d] some Points to be observed in the Process." [3. M]r. Watson Smith, "The Action of certain Sol[utio]n[s] upon Aluminium and Zinc."

Medical, 11, Chandos-street, W., $8\frac{1}{2}$ p.m.

Victoria Institute, 8, Adelphi-terrace, W.C., 4[½ p.]m. Mr. S. T. Klein, "The Conception of the [...] Reality."

TUESDAY, APRIL 12...SOCIETY OF ARTS, John-[street,] Adelphi, W.C., $4\frac{1}{2}$ p.m. (Colonial Section.) [Mr.] Ben. H. Morgan, "The Regeneration of [Sou]t[h] Africa."

Asiatic, 22, Albemarle-street, W., 3 p.m.

Royal Institution, Albemarle-street, W., 5 [p.]m. Prof. L. C. Miall, "The Transformatio[n of] Animals." (Lecture I.)

Medical and Chirurgical, 20, Hanover-square, [W.,] $8\frac{1}{2}$ p.m.

Civil Engineers, 25, Great George-street, [S.W.,] 8 p.m. Mr. Edwin William de Rusett, "R[ecent] Developments in Cargo and Interm[ediate] Steamers."

Colonial Institution, Whitehall-rooms, Whit[eha]ll-place, S.W., 8 p.m. Mr. Frederick She[lfor]d, "The Development of West Africa by Railw[ays]."

Pharmaceutical, 17, Bloomsbury-square, W.[C.,] 8 p.m.

WEDNESDAY, APRIL 13...SOCIETY OF ARTS, John-s[treet,] Adelphi, W.C., 8 p.m. Mr. J. C. M[...] "Agricultural Education."

Geological, Burlington house, W., 8 p.m. 1. [Mr.] Henry Nathaniel Davies, "The Discove[ry of] Human Remains beneath the Stalagmite-Flo[or of] Gough's Cavern, near Cheddar." 2. [Dr.] Giuseppe de Lorenzo (communicated by [Sir] Archibald Geikie), "The History of Vol[can]i[c] Action in the Phlegræan Fields."

Japan Society, 20, Hanover-square, W., $8\frac{1}{2}$ [p.m.] Prof. Lafcadio Hearn, "The Nun Ryonen; [frag]ments of a Japanese Biography."

Royal Literary Fund, 7, Adelphi-terrace, W.[C.,] 3 p.m.

Sanitary Engineers, 19, Bloomsbury-square, W.[C.,] 7 p.m. Discussion on "Combined Drainage."

Dante Society, 22, Albemarle-street, W., $8\frac{1}{2}$ [p.m.] Mrs. Craigie (John Oliver Hobbs), "The A[rt of] Portraiture: Dante and Goya."

THURSDAY, APRIL 14...Royal Institution, Albemarle-st[reet,] W., 5 p.m. Prof. Dewar, "Dissociat[ion.]" (Lecture I.)

Electrical Engineers, 25, Great George-street, S.[W.,] 8 p.m. 1. Discussion on paper by Messrs. [K.] Edgcumbe and F. Punga, "Direct-Re[ading] Measuring Instruments for Switchboard [Use.]" 2. Mr. M. B. Field, "Eddy Currents and [Eddy] Current Losses in Cable Sheaths."

Historical, Clifford's Inn Hall Fleet-street, E.[C.,] 5 p.m.

Mathematical, 22, Albemarle-street, W., $5\frac{1}{2}$ p.[m.]

FRIDAY, APRIL 15...Royal Institution, Albemarle-st[ree]t, W., 9 p.m. The Right Rev. Monsignor the C[ount] Vay de Vaya and Luskod, "Korea and [the] Koreans."

Quekett Microscopical Club, 20, Hanover-sq[uar]e, W.C., 8 p.m.

Mechanical Engineers, Storey's-gate, Westmin[ste]r, S.W., 8 p.m. Adjourned Discussion on M[r.] Edouard Sauvage's paper, "Compound Loco[mo]tives in France."

SATURDAY, APRIL 16...Royal Institution, Albemarle-st[reet,] W., 3 p.m. Mr. Cyril Davenport, "Mezzoti[nts.]"

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FRIDAY, APRIL 15, 1904.

ll communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

NEXT WEEK.

TUESDAY, APRIL 19, 8 p.m. (Applied Art ection.) ALFRED EAST, A.R.A., "The ntiment of Decoration."

WEDNESDAY, APRIL 20, 8 p.m. (Ordinary eeting.) MERVYN O'GORMAN, M.Inst.C.E., Motor Cars for popular Use."

Further details of the Society's meetings will found at the end of this number.

COLONIAL SECTION.

Tuesday afternoon, April 12th; The Right on. EARL GREY, in the chair.

The paper read was "The Regeneration of uth Africa," by BEN. H. MORGAN.

The paper and report of the discussion ll be published in a future number of the *urnal.*

LISTS OF MEMBERS RESIDING ABROAD.

Lists of members resident abroad have been epared, and can be obtained by members on plication to the Secretary.

The following lists have been printed :—

Members Resident in India, Persia, China, Japan, the Malay Archipelago, &c.
Members Resident in Africa.
Members Resident in Australasia and Polynesia.
4. Members Resident in the Dominion of Canada and Newfoundland.
5. Members Resident in the West Indies and British, South, and Central American Colonies.
6. Members Resident in the United States of America.
7. Members Resident in South and Central America and Mexico.
8. Members Resident on the Continent of Europe.

CASES FOR JOURNAL.

Some members have expressed a desire to be supplied with cases to hold the numbers of the *Journal* as they are issued and before a volume is completed for binding. The binders have prepared and lettered a box in book form (Stone's patent box) to match the cloth-bound volumes of the *Journal*, which will contain all the numbers forming a volume. These boxes can be supplied to members (at a charge of four shillings each) on application to the Secretary.

LIST OF MEMBERS.

The new edition of the List of Members of the Society is now ready, and can be obtained by members on application to the Secretary.

Proceedings of the Society.

SIXTEENTH ORDINARY MEETING.

Wednesday, April 13, 1904; LORD MONTEAGLE OF BRANDON, K.P., President of the Irish Agricultural Organisation Society, in the chair.

The following candidates were proposed for election as members of the Society :—

Ambler, Ratcliff V., A.M.I.Mech.E., Messrs. Gibbs and Co., Iquique, Chili, South America.
Bobbili, The Maharajah of, K.C.I.E., Sanasthanam Huzur Office, Bobbili, India.
Cattley, James Edward, 24, Uxbridge-road, Ealing, W.
Chippendale, Arthur, International Banking Corporation, Coliseo Nuevo 4, Mexico City, Mexico.

Currey, Percivall, F.R.I.B.A., 37, Norfolk-street, Strand, W.C.

Dinanath, Rao Bahadur Trikamlal, Dewan of Dharampur State, Dharampur, Surat, Bombay, India.

Dingwall, William Burliston Abigail, Sta. Maria de la Paz, Apartado 116, Matehuala, San Luis Potosi, Mexico.

Dudley, Dr. Charles B., Pennsylvania Railroad Company, Altoona, Pennsylvania, U.S.A.

Holdcroft, J. P., Park Terrace, Tunstall, Staffs.

Jennings, Lieut.-Colonel Robert Henry, R.E., C.S.I., The Residency, Jodhpore, Rajputana, India.

Khan, Colonel Nawab Muhammed Aslam, Khan Bahadur, C.I.E., Peshawar, North West Frontier Province, India.

Kirkby, Reginald Guy, A.R.I.B.A., P.O. Box 7, Pietermaritzburg, Natal, South Africa.

Lawrence, Christian William, J.P., Sandywell-park, Andoversford R.S.O., Gloucestershire.

Morgan, William Houlston, Rhayader, Mid-Wales.

Pittar, Albert Vyvyan, A.M.I.Mech.E., 51, Primrose buildings, Fraser-street (P.O. Box 5627), Johannesburg, Transvaal, South Africa.

Pratt, John, 502, East Fifth-street, Chattanooga, Tennessee, U.S.A.

Sjögren, Professor Hjalmar, Academy of Science, Stockholm, Sweden.

Taberner, Captain William, R.E. (V.), Orrell Hall, Wigan.

Vijaydevji, Kumar Shri, Dharampur, Surat, Bombay, India.

Wigan, Mrs., 2, Cavendish-place, W.

Wilson, C. Herbert, J.P., F.G.S., The Associated Financial Corporation, Limited, Pine Creek, Port Darwin, North Australia.

The following candidates were balloted for and duly elected members of the Society:—

Brett, Jasper, Sir Jamsetjee Jeejeebhoy School of Art, Hornby-road, Bombay, India.

Chapman, A. H., Kurow, Oamaru, New Zealand.

Finlay, James Fairbairn, C.S.I., India Office, S.W.

Fitz-William, C. B. Raoul, 29, Henry-street, Port of Spain, Trinidad, British West Indies.

Hambling, William George A., Forest-house, Queen's-road, Reading, Berks.

Hocart, James Hamilton, 28, High-street, Lambeth, S.E.

Jooste, William J., Rand Club, Johannesburg, Transvaal, South Africa.

Jopling-Rowe, Mrs. Louise, 7, Pembroke-gardens, Kensington, W.

Taylor, Herbert, Boston-house, Kingston-crescent, Portsmouth.

Windschuegl, Charles H., Leadenhall-buildings, 1, Leadenhall-street, E.C.

The CHAIRMAN said:—I feel it a great honour to have been asked to preside at this meeting, and I look forward with lively interest to the discussion on Mr. Medd's suggestive paper. But I come here quite as a learner. I know but little of the English system of agricultural education—if Mr. Medd will allow the word "system" at all in this connection—and still less of foreign and colonial systems, so I can in no way be regarded as an authority on the question and I suppose the only reason for my occupy ing the chair this evening is, that I know something of the practical working of the system lately started in Ireland, which we who are concerned in it hope is worthy of that name Happily, during the last few years, the attitude o the public and of educational authorities in thi country towards rural education has been greatl changed, not to say revolutionised, and this ha been largely due to the efforts of Mr. Medd and others. In fact it has now become a truism tha a unity of purpose should run through the whol system, and that while avoiding premature specialisa tion, regard should be had from the very beginnin in rural districts to the requirements of life unde modern conditions. Now this unity must b preserved in two directions. It must be main tained in a vertical direction from bottom to top— from the primary school through the superior primary the secondary, the agricultural college, and in m opinion should not stop until it culminates in th university. But secondly, it should permeate th country, also in a horizontal direction so to speak and preserve not a rigid uniformity, but a unity o spirit, a harmony and correspondence of part forming one living body—one national whole Now there may be difficulties about the firs process, the co-ordination of the different stages o primary, middle, and higher schools where two o more Government departments are concerned and I am bound to say we in Ireland hav not as yet made much progress in this particula branch of the work, and the primary schoo are still practically untouched. I understand however, that this is not where the shoe pinches wit you in England, and that the difficulty here is rath what I have called the horizontal unity—the co ordination not of grades but of districts—that defective. This, I suppose, is partly due to the fa that the English endowment was a stroke of luck i the sudden windfall of the "drink" money. Bu our Irish endowment, on the other hand, wa bestowed by the constructive statesmanship of m friend, Mr. Gerald Balfour, who carefully provide for a due balance of powers and responsibilities—o local effort with Government control—of local contr butions with Government subsidies, and last not lea of popular representation associated with the offici Executive. And though the Irish Department is no yet five years old and can hardly be expected to hav achieved educational results by which it could fair be judged, I think I may safely say they have solve

e question of setting up a system homogeneous and herent enough to give a distinct impulse and a finite direction to the development not only of e natural resources of the country but of the tural aptitudes of its people as a whole, and et remain sufficiently elastic to suit the special eeds and circumstances of different districts. uriously enough I find that the amount of the ish Department's endowment appropriated to gricultural education and development during the ear 1902-3 was £88,000—practically the same as the drink money" allocated to local authorities for the ame purpose in England. It is for competent nglish authorities to decide whether so large a sum ould not be better utilised if it were administered y a responsible central department, always proided this latter had associated with it a council or oard representative of the agricultural community, hich would assist in laying down the general lines f policy to be pursued for the whole country.

The paper read was—

AGRICULTURAL EDUCATION.

By J. C. Medd.

"The mental and manual equipment of the ising generation of farmers is an object that hat can yield to none in national importance." These words from Dr. Somerville's last Report xpress a truth upon which it is now no onger necessary to insist. We are all agreed hat if the British farmer is to compete upon qual terms with his foreign rivals he must enjoy similar educational advantages. We have realised that success in farming demands extensive scientific knowledge quite as much as thorough practical training, and the development in the facilities for instruction since 1888 has been remarkable. In that year, it will be remembered, the Government, acting upon the recommendations of Sir Richard Paget's Departmental Committee, first adopted the policy of giving direct aid to agricultural and dairy schools by specific annual grants. These have slowly but steadily risen from £2,610 in 1889, to £9,764 6s. 1d., including the special grants for experiment and research, for the year 1902-1903. Such a sum appears insignificant when compared with the vast State expenditure upon agricultural education in the United States, Canada, France, Wurtemberg, and Denmark, but it does not include the cost incurred by the Board of Agriculture in the necessary inspection of the institutions aided, nor does it take any account of what is expended by local authorities out of the Residue Grant under the Local Taxation (Customs and Excise) Act, 1890. From this source no less than £88,212 were devoted to various forms of agricultural instruction for the year 1901-1902, as appears from the Returns published by the Board of Agriculture. The following valuable comparative summary of the Returns was prepared by Mr. Oldman, Secretary to the National Associaton for the Promotion of Technical and Secondary Education, and published in the *Record** :—

	Total Amounts of Grants.			No of County Councils making Grants.		
	1899-1900.	1900-1.	1901-2.	1899-1900.	1900-1.	1901-2.
	£	£	£			
Colleges and Schools	25,616	34,929	29,982	46	49	49
Scholarships and Exhibitions	8,256	9,330	11,169	46	43	48
Local Classes or Lectures for—						
Horticulture	10,386	9,188	10,790	44	39	46
Dairying	9,696	8,663	11,430	42	37	40
Agriculture	5,997	6,284	5.592	31	31	32
Poultry-keeping	2,563	2,530	3,241	35	36	37
Farriery, &c.	2,490	2,524	3,184	28	25	31
Manual Processes	2,282	3,166	2,784	19	22	18
Bee keeping	857	1.399	1,275	25	30	34
General and Miscellaneous	9,003	9,640	8,765	37	39	37
Totals	£77,146	£87,593	£88,212	—	—	—

* The *Record*, vol. xiii., No. 53, p. 13.

This represents a total outlay by the Government and by local authorities of nearly £100,000 per annum, an amount of which agriculturists have no reason to complain. But two questions immediately suggest themselves. First, can we rely upon a similar expenditure in future? At the date to which the above figures refer, the Education Act of 1902 was not in operation. The appropriation of the "whiskey" money was then restricted to technical instruction. It is now definitely allocated to all branches of higher education, and education committees are called upon to provide out of it, together with a two-penny rate, and in some localities an additional penny, for the maintenance of secondary schools of all types, new secondary schools, university and higher technical training, technical (including agricultural and technological) instruction, scholarships and exhibitions, and the training of teachers. It is obvious that the funds at the disposal of county councils, even when the maximum rate is levied, which it will be extremely difficult to levy in rural districts, are wholly inadequate to the satisfaction of all these obligations, and the interests of agriculture may suffer. Although agricultural education committees have been formed in most counties, it is none the less incumbent upon agriculturists generally to urge their claims, if they are not to be stifled by other equally pressing demands. At the same time the changes effected by the Act of 1902 afford good ground for appealing to the Government, that the Board of Agriculture be entrusted with larger funds for educational purposes.

Secondly, has the money hitherto been expended to the best advantage? Are the results commensurate with the cost? Have the various colleges, schools and classes, succeeded in attracting pupils identified with the land, and likely to be engaged in agricultural pursuits? Have the prejudices of the farmer and his love of routine been overcome? Does the agriculture of the country show appreciable improvement after the efforts of the past fifteen years? That there are peculiar difficulties incidental to agricultural education in every country, I am fully aware, but it is futile to ignore these questions. Upon the answer to them must mainly depend the continuance of local aid on the same scale as heretofore, and the justification for an appeal for increased assistance from the State. No general answer can, of course, be given: the conditions vary too widely. But we have sufficient data upon which to form a fairly accurate opinion. Where there has been failure, it does not, by one iota, diminish the value of agricultural education in itself, it rather indicates defective method.

What, then, is the present situation? Every foreigner, visiting England, is at once struck by the absence of anything in the nature of a system. We rightly pride ourselves upon our jealousy of State interference and our preference for private initiative, but there is a point at which this disinclination to accept State guidance becomes a positive evil. To-day, while some counties have elaborated excellent schemes with carefully graduated courses of instruction from the primary school to the most advanced college, in others, large districts, frequently those in which the art of farming has sunk to the lowest ebb, are devoid of any systematic instruction. Spasmodic and ineffectual lectures may occasionally be given, but often the only person to derive any tangible benefit from them is the person paid for delivering them. In fact, it would not be easy to exaggerate the harm done in the past by sending, as pioneers, men with no knowledge of farming beyond that of a text-book, and speaking a language unintelligible to labourers. It will probably take a generation to eradicate the impression thus created, and to win the confidence of village people. Warned by our injudicious employment of itinerant instructors, the Irish Department have resolutely set their face against sanctioning attempts at this branch of agricultural education, until the trained and properly qualified teacher is available. In the words of their last Report, "not only is serious mischief done by bad teaching to those who are subjected to it, but in the districts where it is practised it ends by discrediting and setting back the cause of agricultural education for many years."

The Agricultural Education Committee.

With the view of introducing some uniformity, and placing unrelated effort upon a more systematic basis, the Agricultural Education Committee in October, 1901, passed the following resolutions:—

1. That, if the Board of Agriculture retain their present educational work, it is essential that there shall be complete co-operation between that Board and the Board of Education on all educational matters specially affecting the agricultural classes.

2. That for purposes of agricultural education the country should be divided into districts, and such inspectors appointed as may be necessary.

3. That groups of counties, not yet affiliated to any

ollegiate centre, should be formed, each group being ffiliated to some centre.

4. That, after due inquiry, reports should be issued ealing with the most appropriate forms of agricul-ural education for each county.

5. That permanent Demonstration Stations should e organised in each county or group of counties.

6. That official information bearing upon all matters f agricultural interest, whether agricultural or other-vise, should be distributed to the public free of cost.

7. That to carry out the above objects it is essential hat larger funds be placed at the disposal of the Board of Agriculture for agricultural purposes.

8. That the work of the Board of Agriculture night be facilitated by the appointment of a con-ultative committee on the analogy of those of the Board of Education and of the Department of Agriculture in Ireland.

With this policy, which approximates closely to that obtaining in Ireland and France, the late Mr. Hanbury expressed his general agreement. Effect has been partially given to some of the suggestions, but much remains to be done. No friction or conflict of opinion appears to have arisen between the Boards of Education and Agriculture, and they have loyally co-operated to promote agri-cultural welfare. It is, however, still urged n influential quarters that the educational functions of the latter should be transferred to he former, as provided by the Board of Education Act, 1899. That a single central authority should be alone responsible for all natters relating to education appears natural, but it is doubtful whether the transfer of duties would operate to the benefit of agriculture. The Board of Education is not popular with he farmer, and proposals emanating from it would always be regarded with suspicion. To create what one may term an adequate agri-cultural atmosphere within its walls would be a long and tedious process. Litttle fault can be found with the educational work of the Board of Agriculture, so far as the small funds of which it disposes admit, and there is no eason why this work should not be extended so as to meet all the requirements of the case. The fact that the Act of 1902 refers to the Board of Education as the body to be consulted by local authorities in regard to the supply of education of every type presents no obstacle, or it is improbable that that Board would eject any scheme approved by the Board of Agriculture. Their respective duties would in ime become clearly defined and recognised. Elsewhere no difficulty has been experienced rom having a dual authority. In France, for in-tance, the Ministries of Agriculture and Public Instruction have joint charge of the agricultural education of the country. Such agricultural or horticultural instruction as is given in primary and higher primary schools and in the normal (training) schools falls within the sphere of the latter authority, all beyond it within that of the former. The departmental professors of agriculture, whose duties are the general in-struction of adults in the service of the Ministry of Agriculture, and teaching in the normal schools, in the service of the Ministry of Public Instruction, receive half their salary from the one ministry, and half from the other. The arrangement works with perfect smoothness.

The inspectorate has been increased, but, if the Board is to be kept in complete touch with local activity, additional inspectors are still needed, and they should be definitely assigned to particular areas.

The tendency of counties to group themselves in affiliation to some collegiate centre, has developed, and steps in this direction have been taken in the south-west of England. Some few counties, however, have no organic connection with any institution for higher education.

Although the advice of the Board has been sought to an increasing extent, it does not appear that the Board has *suo motu* reported upon, or suggested schemes of instruction appropriate to, the varying circumstances of different counties. Were this work seriously undertaken, it could hardly fail to be of con-siderable service. There would be no obliga-tion upon any local authority to adopt the suggested scheme, but it would at least afford a definite proposal for discussion. Official experts, familiar with the agricultural charac-teristics and educational developments of each county, might reasonably be expected to devise a more practicable and effective scheme than those whose experience must necessarily be less extensive.

In Ireland, as early as possible in summer, the Department prepares in outline, a number of schemes which are likely to prove of advan-tage to the whole country. These schemes are then submitted to the Agricultural Board, and, if this body approve of them and concur in the application thereto of the necessary funds, the schemes are forthwith sent to each of the thirty-three county committees. The committee meet as early as possible in autumn, and, with the assistance of an inspector of the Department, select the schemes which are most appropriate to their county, and arrange details to suit local needs. The schemes, with

an estimate of their cost, are then returned to the department, whose approval is accompanied by a statement of the proportion of the cost which they are prepared to contribute. In the non-congested districts this proportion has hitherto been one half, and in districts partially congested, five-ninths.*

The question of demonstration plots has been actively taken up by the Agricultural Education Association, and their development is only a matter of time. It has become realised that the multiplication of plots for experiment and research, unless with some very special purpose, is a mistake. In Rothamsted, the country has an institution with unique facilities for long-continued research upon identical lines, which is the essential condition for scientific and reliable experiment. What the individual counties need, are fields or plots to illustrate and explain the results of protracted investigation. But, if Rothamsted is to develop its national work in the future, and continue to be the leader of the highest agricultural research, it must receive some national assistance. Being essentially non-local, it cannot be aided by any county councils. It supplies the material, however, of the instruction given by every agricultural teacher in the United Kingdom, and apparently its own resources must be supplemented by the State, if they are to be adequate to the increasing demands upon them.

Valuable though the literature issued by the Board is, it is too limited in quantity, and has not yet been made sufficiently accessible. Comparatively few people, whose interest ought to be aroused, care to apply to the Board for it, and the channels through which it is usually distributed, are very circumscribed in their operations. Attractive and popular leaflets upon all phases of agriculture and horticulture should be supplied to every cultivator. If the lethargy of the farmer is to be dissipated, the Board must go to him: he will not go to the Board. The highest importance is attached, by the department at Washington, to its publications, and it is the custom to supply each senator and representative in Congress, with several thousand copies of the farmers bulletins, for distribution among his constituents.

The educational funds disposed of by the Board in 1902-1903 were £995 19s. 3d. in excess of those of the previous year, and grants were made for the first time to the Harper-Adams Agricultural College, th Cheshire Agricultural and Horticultural Scho at Holmes Chapel, the East Sussex Agricu tural College at Uckfield, the Harris Institut at Preston, and the Cumberland-Westmor land Farm School, as well as to the Somers County Experimental Farm at Bickenhal This is satisfactory so far as it goes, but th funds are miserably inadequate. The Boar should have enough to treat all counties up terms of equality or it should have no funds f educational purposes. It is unfair that o district should be in receipt of financial ai which is denied to another. It has to b recognised that with the exception of suc private institutions, as the Cirencester an Downton Colleges with their high fees, n college under existing circumstances can b self-supporting. It must depend upon larg imperial or local subsidies. The Wye Colleg for instance, requires £1,000 a year for i ordinary work and some £80 a year for i experiments from the Board in addition what it receives from the county councils Kent and Surrey. If those counties whic have no college for advanced instruction an are not affiliated to any collegiate centre, a to be put on a level with the rest of the countr the Board must be more generously treated b the Exchequer, for it is improbable that th counties concerned can find the necessa money in view of the enormous demands up them. Speaking, too, as one of the governin body of Swanley, I feel very strongly th horticultural colleges for women have a rig to some assistance from the Board, provid they submit to inspection and satisfy th Board's requirements.

On many grounds it is to be regretted th the suggestion for the appointment of a co sultative committee was not adopted. T Board of Education has received conspicuo help from its consultative committee. T Irish department is strengthened in the ta of organisation by its consultative co mittee of five members, its Agricultural Boa of twelve members, and its council of 1 members. These various bodies represe by direct appointment or nomination eve agricultural interest in the island, and co stitute an invaluable link between the centr and the local authorities. The official mind thus kept in constant touch with the best l opinion. Similarly in France and Hollan the advisory councils form an integral part their systems of agricultural education. Is lated correspondents, whatever their perso

* "Third Annual Report of the Department of Agriculture, and Technical Instruction for Ireland, 1904," p. 15.

ualifications, can never occupy the same osition, and they have not the advantage of neeting the elected representatives of other listricts in frequent consultation.

The Primary School.

In regard to the future, we must concentrate our efforts upon the "rising generation," and ve must begin with the elementary school—hat is the foundation upon which the whole uperstructure has to be built. No one proposes to attempt to teach the art of farming here, even if it were possible, which it is not, nor does anyone propose to lower the standard of instruction. We cannot insist too strongly upon the necessity of giving the labourer or he farmer as wide and as thorough a grounding in general knowledge, as his school days, whatever their length, admit of. Such knowledge is the essential antecedent to all successful technical instruction, whether it relates to the farm, the garden, the workshop, the factory, or the counting-house. In his last report upon the dairying classes in Wiltshire, Professor Lloyd remarked that, "judging from the writing, spelling, and form of expression of the pupils, they have not been of so high a standing in general knowledge, as were the pupils in past years. Greatly as I value technical education, I doubt whether it is of any use to those who do not possess a proper foundation of elementary education, and this has seemed to me to be lacking in many of the pupils of the Dairy School." I notice, too, that in the examination last June for three scholarships at the Dauntsey Agricultural School, an excellent institution, of the four candidates who competed two obtained 56 and 32 marks only, out of a maximum of 350. This points to some radical defect in their previous education, and we cannot be too careful lest, in our efforts to make the instruction more practical, we actually deprive the child of the means of profiting by the later instruction which we are so anxious for him to obtain. Dissatisfaction with a purely bookish curriculum must not cause us to rush into the opposite extreme. Its unreality has been hitherto the great blemish in the education of the village school, it has been a thing apart from the daily life of the children, and has aimed solely at the requirements of the town. What we have to do is to make rural interests the basis of all the instruction, to foster the child's natural inclination to learn about his surroundings, and inspire him with some love for the country. In this way his mind will be less directed towards urban pursuits, and the cultivation of the land will be regarded with very different feelings. To attain this end, nature-study in the widest sense, taught informally and not as a text-book subject, every form of hand and eye training and cottage-gardening are the most effective instruments. Personally I would utilise cottage-gardening, so far as the elementary school is concerned, to supplement the class lessons by illustrating as great a variety of plant life as possible, and not to teach the art of cultivating flowers or vegetables. Its function should in my opinion be purely educational: horticulture in its technical aspect is appropriate to the evening but not to the day school. It is a matter, however, upon which there is not general agreement. The expense of procuring land, tools, and proper equipment within the school is an obstacle to any universal realisation of the ideal curriculum, but this difficulty will disappear, if the Bill, introduced by Mr. Jesse Collings, becomes law, for it provides that 75 per cent. or 50 per cent. of the cost, as the case may be, shall be defrayed by the Board of Education.

In all that relates to rural primary education the outlook is full of promise. Every effort is being made by the Board of Education and the local authorities to improve the schools upon lines acceptable to agriculturists, and we have already several, which are unsupassed in any country. In 1901 Professor Robertson, Commissioner of Agriculture for Canada, when engaged in organising Sir William Macdonald's scheme for rural education in the Dominion, visited England and after inspecting one of the schools, to which I referred him, wrote that he had seen nothing equal to it elsewhere in Europe or the United States. About a year ago the Director of Education in India was in correspondence with me upon the work of his department, and last autumn one of the Indian inspectors was specially commissioned to study our methods with a view to their imitation. The first report upon rural schools in the Central Provinces of India has just been published. I mention these facts because of the unjust habit of decrying the village school upon every possible occasion. It would be invidious to name individual schools, but I may state that the Bunbury School at Tarporley, Cheshire, is the one, which impressed Professor Robertson so much. Its excellence is due to the liberality and personal interest of the late Miss Eleanor Ormerod. Schools which might serve as models for education

committees are to be found in almost every county. They abound in Kent and Surrey through the stimulating influence of Mr. A. D. Hall. It may not be known to all in this room that for two years, when Principal of the South-Eastern Agricultural College, he voluntarily taught nature study subjects at Wye village school to ascertain exactly what was practicable and expedient. The value of the experience thus gained has been of immeasurable service to the teachers of both these counties.

The Training of Teachers.

Happily, the great majority of teachers are in full sympathy with the movement, but we must have teachers who are thoroughly qualified as well as enthusiastic. It is better to leave rural subjects alone than to teach them badly. The mischief that an incompetent teacher may cause through exciting the ridicule of his critical neighbours can rarely be undone. The facilities, however, now afforded by most local authorities for obtaining the necessary knowledge leave little to be desired. Where it can be arranged, a course of instruction upon Saturdays throughout the year, or for several months, is probably preferable to one of two or three weeks' duration. By attending once a week only a teacher has more time for assimilating the information, and for independent study before and after each lecture. There is a danger that the abundant and very varied food offered at some of the short summer courses may not be properly digested, especially if the student has no previous acquaintance with the subjects. Much good, too, may be done by such Saturday rambles as those so successfully organised in Essex. Matters are not yet quite satisfactory at the training colleges. The requirements of the certificate examinations are exacting, and the time-table is very crowded. There is, moreover, a little uncertainty as to the best methods of instruction, but at Salisbury, Chester, Peterborough, and York, as well as at some of the other colleges, the programmes are upon right lines, although perhaps a little ambitious. Whatever difficulty there may be now will gradually disappear as the demand for the instruction grows, and nature study becomes more and more a recognised feature in all elementary schools.

No better pioneer of agricultural education can be found than the really well-trained teacher. This has been abundantly proved in France, where the teachers go to the villages with a sound theoretical and some practical knowledge of horticulture and agriculture. They are able, in their own gardens, to illustrate the effect of improved methods of cultivation upon their fruit and vegetables. It has been truly observed that though the farmer or labourer is opposed to all progress and reform when he is addressed simply in the name of science or theory, he is ready enough to learn when practice is added to theory, and he can see definite results before him. The confidence of the farmers has been won: they constantly consult the teachers upon plant diseases, the ravages of insects, and the value and use of different chemical manures. On a market day when I was visiting a primary school at Nogent-le-Rotrou (Eure-et-Loir) and talking with the master, a farmer and a gardener called to consult him—the one about his crops, the other about his vines. In many cases, too, the farmers have started experimental plots of their own at the teacher's suggestion and with his assistance. As an encouragement to our teachers to make themselves thoroughly familiar with their surroundings, it might be well for us to adopt the plan, initiated by the *Syndicats Agricoles* in France, of offering prizes annually to teachers for the best accounts of their respective communes. The teachers are invited to furnish particulars as to the system of land tenure, the size of the holdings, the character of the crops and soil, the methods of cultivation, the rent of houses and land, together with other details bearing upon the social and economic condition of the people. This induces the teacher to acquire a vast amount of information which cannot fail to be of service to him in his profession, and it also provides the authorities with a number of very valuable statistics. There does not seem to be any reason why this example should not be followed here. Something of the kind was tried in Hampshire three years ago with encouraging results.

Continuation Schools.

With the object of mitigating the farmer's grievance in regard to child-labour, ending the mischievous half-time system, and paving the way for the universal establishment of continuation schools, I recently suggested that boys of 12 years old, if they had a definite engagement on the land and could pass an examination in "the three R's," should be exempt from further attendance at the day school, provided they attended an evening school for the next three years during the

iter months. The suggestion was favourably eived by the Press, and was supported by ny educationists and such well-known agri-turalists as Mr. Clare Sewell Read. A re-ution embodying this proposal was adopted the East Suffolk Education Committee t month. It is to the evening school that must look for the improvement of the ourer, and the recovery of the skilled or iandy" man, who is almost as extinct as dodo. Everyone familiar with the rural tricts, knows that it is comparatively easy start a class, but not so easy to retain the pils. The instruction must be attractive, ictically useful, and calculated to increase ge-earning capacity. Our aim should be to ike the lad who does not attend an evening iool, feel that he is placed at a disadvan-ge with the one who does. In one or two alities, employers, whose work is sought er, have insisted that their lads shall attend evening school, and it is remarkable iat an effect this has had in stimulating the luntary attendance of others. A striking stance of this has occurred in connection with essrs. Brunner, Mond and Co.'s works in rural districts of Cheshire. The great owth of these schools in Cambridgeshire, ertfordshire, and Surrey, shows that if the oper steps are taken, the difficulties can idily be surmounted. Lessons from books, d lectures are of little, if any value. Lads ist be taught to use their hands as much as ssibie; they should be doing or making mething to begin with, baskets or wood rk. Lessons on gardening may be given in nter to be followed by the cultivation of rdens in spring and summer. It is necessary to describe how much has been complished in this particular direction in rrey. Instruction may then follow upon iit culture generally, market gardening and arketing, farriery, poultry-keeping, bee-eping, and, above all, in the principles and actice of co-operative production and dis-bution. It is no answer to say that a mand for such instruction does not exist; agricultural education especially, as Mr. orace Plunkett observes, the demand has be created. If we could once con-nce our people of the benefits of co-eration, we should, I believe, provide e best object-lesson on the value of learning w to turn the farm or the garden to profitable count. The results achieved by the Irish gricultural Organisation Society must cer-inly have tended to lighten the task of the Department of Agriculture in its educational efforts. We annually import about £5,000,000 worth of eggs, £10,000,000 of fruit and veg-etables, and £125,000 of poultry and game. Much of this trade might remain in our own hands, but knowledge is necessary to engage in it with profit. It is a question of organisation and not simply of climate. Holland, for instance, with no better climatic conditions, sends us yearly an increasing quantity of fruit, when perhaps the plums in Kent are rotting on the ground. In the development, too, of these minor industries we may find an appreciable check to rural migration.

Intermediate Agricultural Education.

One of the hardest problems is to determine the best type of school and form of instruction for lads from 13 or 14 to 16 or 17 years of age. They will be mainly the sons of small farmers, for whom something between the primary school and a collegiate course is required. The experiments at Ashburton and Wellington point to the conclusion that the addition of an agricultural side to an ordinary secondary school does not provide a solution. At one time the farm schools of France attracted con-siderable attention, and in his Report to the Royal Commission on Technical Instruction Mr Jenkins suggested, in imitation of the French plan, that apprentices should be sent to selected farms, the chief difference being that the apprentices were not to perform all the farm labour. North of Bourges, how-ever—that is, in that half of France where agriculture and agricultural education are most advanced — the *fermes écoles* have disappeared, and their place has been taken by *écoles pratiques d'agriculture*. The em-ployment of pupils as farm labourers is felt to be of no educational value. Moreover, the farm schools started in Herefordshire and Huntingdonshire in the middle of the last century did not prove a success, nor was the history of the school farms in Ireland encour-aging. Ridgmount, too, which enjoyed exceptional advantages, has been completely reorganised. "What the young farmer should learn is not," in the words of Professor Wallace, "ordinary farm work, viz., to plough and harrow a given area in the day. He can become an expert in that kind of thing at home to greatest advantage, without cost for instruction, and at the same time prove a valuable aid to his father. He requires to be taught just those things which are not to be learned on an ordinary farm, to have explained

to him the meaning of processes, which are founded upon scientific principles, and to become familiar with the common facts of those sciences which bear upon agricultural practice."

The intermediate practical school of agriculture fulfils Professor Wallace's conditions. It is not an easy school to conduct. Its principal needs qualifications which are not so necessary in the principal of an agricultural college. He should be in complete sympathy with the tenant-farmer, thoroughly understand his difficulties and point of view, and, if possible, know from personal experience how to manage a small farm. Otherwise his influence with the parents of those for whom the school is primarily intended is likely to be slight. Five schools of this type are now in operation; it is too soon, however, to pronounce finally upon the extent to which they really succeed. Some of them have adopted the title of farm schools, but their methods are rightly those of the *écoles pratiques d'agriculture*, not of the *fermes écoles*. Their equipment is excellent; they provide just the grade of instruction required, and upon their horticultural sides, where such exist, have proved an undoubted success. It is as yet a little uncertain how far they can rely upon an adequate supply of pupils, whether their pupils are drawn mainly from the agricultural classes and are destined for agricultural careers, and what the attitude of the farmer is, one of active interest or merely of indifference. Their failure, if any, is due, apart from local or temporary causes, to the undeveloped state of agricultural opinion, but, until the future of the existing schools is thoroughly assured, it might be prudent to abstain from the great cost of establishing and maintaining more of them.

Winter Schools of Agriculture and Horticulture.

In the meantime, the needs of the class, for whom the intermediate schools are intended, may be provided for by Winter Schools of Agriculture and Horticulture upon the model of those which are proving so successful in Holland. These schools are established in those agricultural or horticultural districts where they are likely to prove of the greatest service. The commune has to provide suitable buildings, and the State defrays the rest of the expenses. Pupils are admitted at the age of 16, but may attend at any age. They have to pass an entrance examination to test their capacity to benefit by the instruction, and must posses some previous practical knowledge of agriculture or horticulture, as the case may be. The full course is for two years, and the classes are held during the winter months for three or four hours in the afternoon on five days a week. The scale of fees is determined by the Minister of the Interior, but may not exceed £1 13s. 4d. a year. Frequently it is below this, and the poor are admitted without payment. The equipment of each school is superb. In agriculture the instruction is wholly theoretical, but there is always a small demonstration plot, and during the summer those who have attended the schools are taken for excursions to well managed farms and other places of agricultural interest. The curriculum comprises chemistry, physics, botany, zoology, the breeding and care of animals, the properties of the soil, tillage, manuring, the cultivation of crops, dairying, rural economy, arithmetic, and farm accounts. In horticulture the pupils have more practical work, and private associations have provided large gardens. In addition to those subjects which bear directly upon the art of gardening, instruction is given in commercial correspondence in French, German, and English—a matter of considerable importance, having regard to the great export trade in bulbs, flowers, fruit, and vegetables. When the schools are not open, the teachers are available to advise the surrounding farmers and gardeners. The prejudice with which they were at first viewed by cultivators generally has now quite disappeared. The good which the schools have done in their respective neighbourhoods is unmistakeable. There is, too, a distinct advantage in thus bringing *systematic* instruction of the highest quality to the people themselves. Even in winter it is not always easy for lads and young men to be spared from work on the land or in the garden for attendance at distant centres. This is felt to be the case in Essex, where the Winter School of Agriculture, which was opened in 1898, somewhat resembles the Dutch schools. The school is popular, but as Mr. Dymond informs me, "farmers cannot easily spare their sons for nine weeks, for the poultry or whatever special jobs the son has to look after, have to be provided for in their absence." There is the further question of expense. Although the instruction is free the cost of board and lodging in Chelmsford is from twelve shillings a week upwards. In Lancashire an allowance not exceeding ten shillings a week is made to students, approved

/ the committee, who attend a full winter ›urse of agricultural instruction at the arris Institute at Preston. Possibly in me some local authorities may adopt the rench system of awarding, in special cases, ursaries of sufficient value to pay parents ›r their son's food, clothes, travelling exenses, &c., and to compensate them partially ›r the sacrifice of what a lad would otherwise e earning.

Higher Agricultural Education.

In regard to higher agricultural education, is now admitted that ordinary farm work annot be successfully combined with scientific eaching. Years ago, this was pointed out by I. E. Risler, Director of the Institut National gronomique at Paris. "If you pursue both ractice and theory," he said, "you will make ad practical men and bad scientific men. Jur pupils require all their life for becoming ractical men, and to become a practical man s really impossible on a farm where there are . hundred students, and which is cultivated vith public money. Practice can only be well aught on a farm where there are only three r four students, where they can really be harged with the carrying out of practical work, he supervision of labourers, and the keeping f accounts. Practice, in fact, requires a inancial aim and a good organisation of all he details of farming for its main purpose, iz., that of making money."

In France the students of the Institut National Agronomique are obliged to pass wo at least out of the three month's vacation t a farm. They have to keep a journal ecording day by day the division of labour at he farm, its purchases, sales, the agricultural perations, the share which they make in them, he prices of agricultural produce, the work nd wages of the labourers. They have also o describe one or more points connected with he rural economy of the district, the peculiar eatures of the farm land, such as irrigation, lrainage, buildings, special products, &c. These residences at farms are of extreme benefit, since they not only impart a large amount of ›ractical information unattainable at a college, ›ut also serve to develop habits of minute ›bservation.

Opinions are a little divided as to whether ›ractical experience on a farm should precede ›r follow the study of scientific agriculture. On the whole, it seems better that the farm vork should come first. At Edinburgh it has een found that the best students are those who, after leaving school, have gone home for two or three years, and made themselves personally familiar with practical work on the farm and with live stock, before going to study the allied sciences, and the principles of agriculture and of stock raising. An objection has been raised that after an easy-going pupilage on a farm a student does not readily take to the hard and more serious demands of scientific study, but this must largely depend upon the station in life to which the student belongs, the conditions of his residence upon the farm, and the objects with which he is acquiring an agricultural education.

In his last report, Dr. Somerville remarked that "more discretion might with advantage be bestowed on the award of diplomas and certificates." A certificate should *per se* be a guarantee that the student has both practical and theoretical knowledge, and not merely that he has attended a course of instruction and passed an examination in the principles of agriculture. It is to be regretted that the examination for the diploma in agriculture under the National Agricultural Examination Board does not necessarily imply that the candidate has had any practical training whatever. In dairying the candidate must satisfy the examiners that he or she has had a thorough training and practical experience in all the details of dairy work as pursued on a farm. The objection might be removed if the agricultural candidates could have a *vivâ voce* examination out of doors in the fields, in addition to the written papers, or if, as at Wye, they were called upon to perform certain manual operations, submit a diary of farm work, a plan and a section, and make certain analyses. At Reading, the diploma is only awarded to students who, after two years at the college, have received practical training for a further period of two years on a recognised farm.

The report of the Departmental Committee on British Forestry emphasised the importance of devoting more attention to this branch of education. Those who have read Arthur Young's "Travels in France" will recollect his deplorable account of the state of the country to the south-west of Orleans. That district by afforestation has been completely reclaimed. M. Denizet, secretary to the Comité Central Agricole de la Sologne, wrote to me, when I was about to visit it in 1900, "Vous y verrez que depuis le voyage que faisait en France en 1787 et 1788 votre compatriote le voyageur

Arthur Young, la Sologne dont il a parlé avec une compassion trop justifiée, a subi la transformation la plus extraordinaire et est devenue une contrée suffisamment fertile et très recherchée pour sa chasse qui y est très-belle." Similarly a vast tract of waste land in Holland has been brought under cultivation by the Société de Bienfaisance. There are thousands of acres in England which could be profitably turned into plantations and woods, but the work ought to be undertaken by a Government Department of Forestry.

Conclusion.

In conclusion, may I briefly sketch the way in which it seems to me that the rural and agricultural education of every county might be coordinated and placed upon a satisfactory basis?

1. Close small village schools and convey their children daily to some central school. This would ensure better buildings and equipment, more regular attendance, and a more efficient staff. This has been already done in parts of the United States and Canada.

2. Develop a few favourably situated schools upon the model of the *écoles primaires supérieures*. The full course at these schools extends over three years, and for the first year the instruction is general. Afterwards the pupils enter one or other of the following sections:—

(*a*) *Commercial.*—In this section prominence is given to book-keeping, modern languages, shorthand, and commercial geography.

(*b*) *Industrial.*—For this a workshop is provided, and the instruction is characterised by more mathematics and technical drawing, as well as by manual work in metal and wood. There is no idea of teaching, or even preparing for, any particular trade. The aim is to develop skilfulness of hand and eye, and general acquaintance with the properties of wood and iron.

(*c*) *Agricultural.*—Very little drawing and more instruction in natural sciences and in manual occupations bearing upon soil culture. The lessons on the theory of natural and physical sciences are supplemented by practical work and by experiments carried out by the pupils themselves.

The schools founded by Lady Warwick at Bigods, and by the Duchess of Sutherland at Goldspie, are somewhat analogous to these.

3. Organise a continuation school in every village with such a curriculum as that previously described.

4. Establish winter schools of agricult and horticulture in selected districts accord to the particular requirements and charact istics of each county, and make the servi of their directors available for all farmers a gardeners during the summer.

5. Put demonstration plots in the charge men who combine scientific accuracy w some actual knowledge of practical farmi and are in touch with the farmers of district.

6. Provide liberal scholarships to p capable children by successive stages from elementary school to the collegiate centre, which each county should be affiliated.

Note.—The following figures afford gratify evidence that the facilities offered at institutions varying grades are being more and more wic appreciated:—Fifty-four pupils passed through Basing School Farm (which can only accommod 16 pupils at a time) last year, of whom 90 per ce were the sons and daughters of farmers. The num of boarders at the Dauntsey Agricultural Scho which is too isolated for many day pupils, has ri from 11 in 1900 to 38 in 1904; of these, almost follow the agricultural course. At the Harper Ada Agricultural College, the number of students is about 70 per cent. of whom are the sons of lan owners, land agents, or farmers. Within the past t years, the number at Wye Agricultural College h increased from 49 to 72, about half of whom are birth associated with the land.

DISCUSSION.

Mr. Jesse Collings, M.P., said that he w more interested in that portion of the paper wh related to the elementary schools, and to the attenti given to the rising generation of farmers, but th must remember that, to the misfortune of the natio England had ceased to be an agricultural count and he did not know where the rising generation farmers was to be found. The paper spoke abo the rural scholar going from the bottom to the to and getting a scholarship; but when he had do that, what then. Where was his career? T question of agricultural education was part of anoth question. Though children might receive an agricu tural education on the land, they could not be ke on the land until they had better prospects than th had now. His own opinion was that the agricultur education given to children should relate agriculture in its widest sense, and that the tas for agriculture on the part of children shou be formed during school age. Every rural scho should have a school garden in which agricultur operations could be performed by an ab teacher and by the children. He embodied th

lod in a Bill which he introduced ten years ago was reintroducing now. As to general education, children should be well grounded in reading, ing, and arithmetic, and after that the natural cts connected with agriculture would be subjects calculated to develop all that was good in a l. There could not be anything better for :ating a child and developing his power of obser- on and his ability to see things than the study of ire. This must be accompanied by leading the dren to learn by doing. He attached the greatest ortance to education of this kind being given oughly in the elementary schools. The elementary ools should be the feeders of the later schools in ch agricultural education was given. Unless this the case, the secondary schools would be failures the want of being fed from below. He believed : the proper idea had hardly entered the mind of the ication Department. That Department had been enamoured of book learning, and if a revival of iculture was ever to be brought about—assuming t it was possible at all—the Education Depart- nt must turn over a new leaf, and inducements st be given to teachers to qualify practically for ching in village schools. At present all the plums eaching went to the urban teacher. It was need- to recognise that the highest thing for a nation s to be an agricultural nation. No nation ever ined its power, its health, and its vigour merely commercial prosperity. Agriculture was the kbone, and social reformers ought to press that t on the Government. Agricultural and rural ricts must have the first attention of the Board of riculture and the Education Department.

Ir. H. T. EVE, K.C., M.P., said that he attended h peculiar interest, mainly because the constitu- y which he represented would shortly have consider in what way they could best turn to ount the very magnificent legacy of which they l become possessed under the will of his pre- essor, Mr. Seale Hayne. That gentleman's duary estate had been bequeathed to his trustees n trust to found and establish in the constituency ch he represented for so long, an educational ege directly connected with agriculture. It would of course a lamentable thing if that generosity was applied. He hoped that the college to be founded ld be such a centre for the south-western nties of England as Mr. Medd had indicated. He not qnite take the view of agriculture which Mr. se Collings had taken. He thought that persons e apt to mix up cause and effect in considering conditions of agriculture. He had never yet met h a man who did not feel himself competent to a farmer, whatever his previous avocations might e been, or however he had failed in them. And erson of that sort was very often the first to ertise for the reception of farm pupils. The lt of such a course was inevitable bankruptcy. is experience a very large amount of agricultural depression and bad farming had arisen from want of knowledge. He believed that many farmers who were now suffering from agricultural depression would have been in a position of comfort and prosperity if they had had a sound and proper agricultural education. It would be a lamentable thing to countenance the feeling that agriculture in this country was a doomed industry. He knew of nothing more likely to restore agriculture than a sound agricultural education, beginning, if they liked, at the elementary school. With regard to the employment of boys on farms in the daytime and their compulsory attendance at night schools, he might state that the farmers of Devon considered that as a rule boys were not desirable adjuncts to a farm. They were apt to be exceedingly "cheeky," and when they got together they were not peculiarly industrious. The farmers of Devon were suspicious that the introduction of anything like boy labour would be calculated to hinder rather than promote the interests of the farm.

Sir PHILIP MAGNUS said that he considered that the question before the meeting was one of the most important which such a Society as this could consider. His own work had been almost exclusively connected with arranging schemes of instruction for trade teaching, and teaching intended to promote manufacturing industries. But he could not but recognise that agriculture was one of the most important industries that any country could undertake, and that it was of very great importance that agricultural education should be improved. It appeared to be a reproach to this nation that it could grow so little of its own food. He was inclined to agree that it would be an advantage for the Board of Agriculture to continue the direction of agricultural education, and not to hand it over to the Board of Education. The latter was already overworked. A matter referred to by Mr. Medd, and taken up by Mr. Jesse Collings, appeared to him to be of the greatest possible importance, and to lie at the root of nearly the whole question, and that was the primary or elementary education of the children. He attached great importance to the remark in the paper that what we had to do was to make rural interests the base of all the instruction. That really ought to be the object of primary education in the rural schools. At present primary education was in an unsatisfactory condition. The instruction given was of a too bookish character, and was not sufficiently practical. He had come to the conclusion that it would be well if one-half of the time of every child in every primary school was devoted to practical pursuits. In rural districts those practical pursuits would of course refer to agricultural matters. He was convinced that a child would learn more readily to read and write and reckon if its time was not wholly occupied with books. As Mr. Jesse Collings had pointed out, rural pursuits tended to train those faculties of observation which

were of the utmost importance in after life. He was not so much disposed as Mr. Medd was to think that evening continuation schools were altogether successful in rural districts. Such schools were of the greatest possible advantage in towns, but in country districts, where the population was very scattered, it was not, he thought, worth while to spend money on them. Mr. Medd had suggested that large central schools should be substituted for small village schools. Did he mean that this country should adopt the system practised in the United States of conveying children to schools in vans.

Mr. MEDD replied that he did.

Sir PHILIP MAGNUS said that he thought that there would be some advantages in that plan. He could not help sympathising with parents who kept their children away from school on rainy days when the school was a long way from the home. One of the most important questions connected with agricultural education was the higher education and training of teachers. It was certain that unless we got the right sort of teachers we should not succeed in giving an agricultural education or inducing that love of the country which would bind the children to the land.

Mr. A. D. HALL said there was a tendency on the part of people who spoke on education to dwell upon what was lacking, but he thought that on an occasion like that they ought to take note of the enormous strides which the country had made within the last twelve years in agricultural education. The agricultural education which had already grown up took its start only ten or twelve years ago, and the farmers had rallied round the men who had been working in their interests. The change in the feeling of the ordinary working farmer with regard to this matter was something which only those persons who had been engaged in the work of education could realise. In every part of the country where there was an agricultural college, or some establishment of the kind, that establishment had become an integral part of the life and of the system of operations of the most intelligent farmers. He did not think that there remained any very great new step to be made in many parts of the country. The organisation existed, and there was every facility for development as the public demand grew. When the personal influence of those who had been to the colleges spread and permeated the mass of the people, future developments would grow up naturally. There were, however, series of great gaps all over the country, and there were counties in which there was no organisation. Some counties were too small to run an institution of their own, and were unwilling to co-operate with other places. It was in these areas that stimulus was wanted. In such places, the Board of Agriculture had its opportunity if only public opinion would provide that body with more funds. The question was entirely one of funds. At present the op- tions of the Board of Agriculture were restricted schools and colleges of a certain rank. Perhaps most pressing necessity at the present time wa rope in those areas which lacked any organisatio the present time. Turning to the question elementary schools, he thought that the great n was the supply of teachers. There was a fee that elementary schools should educate the chil in the direction of country life, but there was no vision for providing teachers qualified for such w The training colleges educated only a small fract of the teachers, and nineteen teachers out of twe belonging to that fraction were drawn from the tow But little could be done unless the whole of the fut teachers were swept through the training colleges, for this result we must look to the county counc Agricultural instruction ought to be given in training colleges, not as a new subject in an alre overloaded curriculum, but as part of the whole lif the teacher while he was at the college. There m be a kind of "feeling" rather than definite instruct in any particular subject. In an instance which come under his observation a teacher had started teaching of botany, and one day he (Mr. Hall) to up the notebook of one of the pupils, and fou it contained nothing but scientific descriptive ter The teacher was really in earnest, but this depl able result was due to the attempt to teach defi subjects. The teaching ought to be a meth which would colour all the views of the pupils looking at life rather than any specific instructio this or that ology.

Mr. G. LAMBERT, M.P., said that they were proba all agreed as to the value of giving agricultu education, but what he wanted to know was how was to be done. That seemed to him to be the of the whole matter. How were the boys to be k upon the land, and what sort of education wo conduce to that desirable result. He did not qu agree with Mr. Jesse Collings in thinking that th was no rising race of farmers in England. If th could teach agriculturalists how to produce grea results upon their farms and reap greater profits, t would do some good, for, as had been once remark education was of no use unless it taught a man h to live. But he wanted to come down to the bott of the question and ask how the agricultural educati was to be given. Any suggestions on that po would well deserve the attention of Parliament. agreed with Mr. Medd that it would be a mistake transfer agricultural education from the Board Agriculture to the Board of Education. But should like the Board of Education to circul among the county councils information as to the b method of devoting the funds which they had dispose of to agricultural education. He agreed w what had been said as to the splendid results wh had accrued from the experiments at Rothamst That was not a county institution but a national o

ev. RICHARD ADDY (member of the East folk County Council) said that he had pro- ed in that body that boys who intended to age in agricultural pursuits should, with the sent of their parents, leave school at twelve rs of age, but be compelled to attend a night ool until they were sixteen. The Education nmittee of the East Suffolk County Council pted the proposal by 15 votes to 3; and, in the rwich Diocesan Conference, it was passed last k by a very large majority. He had had a large erience of night schools, and that experience wed him that boys who left the day school eleven or twelve, passed naturally from the mentary school into the night school, and that y would continue there until they were 20, that if they stayed at the day school, until y were 14, they did not pass naturally into night school and only a portion of them would r attend it. It was notorious that what boys rnt in an elementary school before they were 14 duced very shallow and very transitory impressions, d that what they learnt at from 14 to 16 impressed m much more deeply and was more likely to nain permanently in their minds. It was well own that large portions of the agricultural dis- cts were becoming depopulated, and that there s a great scarcity of farm labour in them. The population was generally attributed to the rest- sness of the age, to the higher wages paid in e towns, and to the amusements and excitements of wn life. But he thought that the depopulation s due in a great measure to our system of edu- ion and to boys being kept at school until they re 14. At that age they became unmanageable, l the farmers could not get them to take any erest in their work, and consequently they drifted to towns. The effect of the education that was given them at present was to lead them to settle in the vns. He did not want all the boys to be kept in country, but there were a great many boys who re interested in country life, and many of these re failures in the towns. The interest of such boys country life would be very largely cultivated and nulated if they were set to farm work during the ytime and attended a night school. The great nt was to get them at a teachable age. The o years from 12 to 14 constituted the most critical e in their history.

Sir THOMAS ELLIOTT, K.C.B., wished to express sincere appreciation of the suggestive paper and of admirable discussion which had followed it. He eed very much with Mr. Lambert in what he l said as to the importance of training boys in ctical work. There were excellent courses of object sons drawn up by the Board of Education in con- ction with the Board of Agriculture, but how p did the teaching ever go? He was looking ward with great hope to the influence of county ncils. They would shortly have for the first time in the rural districts, an educational authority which comprised the best educated and most enterprising men in the country, and he hoped that, when the county councils came to provide schemes of instruction, that instruction would be of a very elastic character. It was to be hoped that it would be less bookish and more adapted to the practical requirements of the country than it had hitherto been. He also hoped that the inspectors of the two departments would be able to influence the various local authorities throughout the country for their good. There were two admirable inspectors acting under the Board of Agriculture, who not only devoted their attention to the great colleges in which the higher instruction was given, but also discussed educational matters informally with the leading men of the local authorities in order to bring the experience and the special knowledge of the central department to bear upon the local work. During the last fourteen years, a system of higher agricultural education had been built up, which he thought surprised even those persons who had been associated with it from the outset. It was most important always to be aware of the danger of terms, such as "agriculture" and "farmer." He always tried to train himself to ask what kind of agriculture, and what kind of farmer was meant. There were various classes of farmers and their needs had to be provided for very differently. There must be elastricity in any scheme which was set up. They wanted a ladder, but they also wanted suitable education for all the various grades of agri- cultural life which had to be dealt with. The Board of Agriculture would bear fully in mind the very suggestive paper and discussion, and he would personally bring them under the notice of Lord Onslow. He hoped that some practical good might come out of them.

On the motion of the CHAIRMAN, a vote of thanks was accorded to Mr. Medd for his paper.

Miscellaneous.

ADMIRALTY CHARTS.

The following is the official list of charts issued by the Hydrographic Department of the Admiralty, in January and February last:—

New Charts.—No. 3346—Germany; Jade and Weser rivers; plans:—Nordenham, Bremerhaven, and Geestemünde docks, Vegesack, Brake docks, Elsfleth, Bremen docks. 3411—Africa; anchorages on the west coast; Garraway anchorage. 3396—Japan; Nippon, north-west coast:—Port Susa. 2658—Solomon islands; Florida island:—Gavutu and Tulagi harbours. 1320—Spain, south-east coast; Cape San Antonio to Cape Tortosa; plan added:—Valencia, outer anchorage. 2067—British Columbia; harbours in discovery passage, &c.; new plan:—

Beaver harbour. 1368—Solomon islands; anchorages in Bauro or San Christoval island; plans added:—Marunga harbour, Star harbour.

Charts that have received additions or corrections too large to be conveniently inserted by hand, and in most cases other than those referred to in the Admiralty Notices to Mariners:—

Nos. 1607—England, east coast:—River Thames; North Foreland to the Nore. 2309—Norway; sheet VII.:—Leka to Donnœsö. 2275—White sea; sheet VII.:—Gulf of Onega. 2300—Baltic sea; Gulf of Bothnia:—Stiernö point to Fiäderäg, &c. 2826—Baltic sea; Gulf of Finland:—Approaches to Viborg. 2694—France:—Channels between Ile d'Ouessant and the mainland. 1676—Greece:—Gulf of Patras and approaches. 3335—Labrador:—Approach to strait of Belle isle. 232B—Newfoundland island. 2171—Nova Scotia:—Sable island. 230—Venezuela:—Margarita island and Gulf of Cariaco. 3188—Gulf of Mexico, Sabine pass. 2689—British Columbia:—Haro and Rosario straits. 759A—Madagascar:—C. St. Andrew to Bevato island. 758—Madagascar:—C. St. Andrew to Antongil bay. 84—Bay of Bengal:—Chittagong river. 1764—China, east coast:—Amoy, inner harbour. 1602—China:—Approaches to the Yang tse kiang. 2809—China, Yang tse kiang:—Shanghai to Nanking. 1270—Korea:—Approaches to Chemulpho anchorage. 1259—Korea:—Fusan harbour. 452—Japan:—Yezo island with adjacent straits. 356—Japan:—Harbours on south coast of Nipon. 2543—New Zealand; sheet II.:—The west coast from Manukau harbour, &c.

These charts are issued by Mr. J. D. Potter, 145, Minories.

COLOMBIAN COFFEE.

The value of Colombian coffee has been and is steadily on the decrease in the markets of Europe and the United States, and, according to a recent report of Vice-Consul Spencer Dickson, during the three years' revolution which came to an end about a year ago, the cultivation of coffee was rendered difficult and its export impossible. Coffee can be grown in almost all parts of the country, where the temperature varies from 59° to 77° Fahr. The Department of Cundinamarca produces the famous Bogota coffee. Coffee is also grown in the districts round Ocaña Cucuta, and Bucaramanga, in the Department of Santander, and in the small valleys of the Cordilleras, rising from the lowlands of the Department of the Tolima, on either side of the River Magdalena. A tree from four to eight years old will yield in small and well-cultivated plantations about one pound of coffee annually. In large and less cared-for plantations the yield is about one half that amount. Of all the coffee produced annually only about 25,000 bags remain in the country for home consumption. Owing to the revolution, exportation has until lately been impossible. Colombian coffee will, therefore, lose favour, as some of that which now being exported is three years old. On the ot hand Brazilian coffee is gaining ground, and Brazilians are cultivating more scientifically ev year. The shade tree most used for coffee plan tions in Colombia is the "Guamo" of the "Ing species. There are, however, many different va tions of this species, and the only one approved the coffee planters is that known as "Guamo R di Mico," so called from the resemblance of the pu which contains the seed, to a monkey's tail. T tree owes its widespread popularity to its adap bility as regards both elevation and climate. T Jack tree of Ceylon is not used in the interior Colombia, being too delicate to stand a long journe Wages on coffee plantations have risen considerabl

Correspondence.

THE REPRESSION OF THE BRITISH INVENTOR.

A very active and important correspondence now taking place in the columns of the *Journal the Society of Arts*, concerning the British Paten laws; there is, however, one point which has n been so far mentioned, although some of our mo eminent men of science have already raised their voic to denounce it. It is the fact that, with the law it is laid in Great Britain a patent cannot be grante for a matter which has been brought before a scienti society. The inventor of some new application scientific principles, likely to be useful either from a industrial or purely scientific point of view, if he e plains it before any learned society, with the aim having it discussed in a scientific manner, and hearing criticisms and suggestions made by compete people, must give up the hope of taking out a vali patent for the same.

I understand the law is different in the Unite States, where the fact of having read such a pape before a scientific society is considered as a suppor of a claim made later on for the application by th author for a patent concerning the invention that wa the subject of his paper.

There are many instances of genuine inventors i Great Britain being deprived from reaping the fruit of their labour by this state of affairs, merely becaus they considered the financial question as secondary and bestowed all their cares in the advance of science by showing their invention to fellow-workers, whil unscrupulous persons were appropriating their idea and patenting them.

The only step that can be taken by the inventor i this case is to attack the patent legally and prove i to be invalid. He cannot take one for himself.

The discussion of the Patent-laws of Great Britain America, and Germany, brings to the light the goo and the evils of each system. This is a very satis

tory starting-point for reorganisation, so that the ls can be avoided and the good preserved. In ıer words, a compromise may be arrived at that uld place the British inventor in even a better uation than his rivals in Germany and the United ates, however these might be envied at present—t always with reason, as shown by Mr. C. D. Abel the *Journal* of February 26th. But will this be the present generation to witness?

The ideal would be an International Patent Office sed on the laws once adopted as most equitable—t this is an Utopia which seems well nigh im-ssible of realisation. M. E. J. GHEURY.

14, London-road, Chelmsford, March 29th, 1904.

THE FISHERY INDUSTRY IN THE FAR EAST.

In this article "garbuta" and "kayta" are spoken as kinds of salmon (see *ante*, p. 437). Both h belong to the genus Oncorhyncus, the former ing *O. gorbuscha*, and the latter *O. Keta*, and ere, until recent years, considered to possess little no food value. Even now, when used at the canneries," they are placed upon the market under sumed names.

G. H. PADDOCK, F.Z.S.

Mill Bank, Wellington, Salop.

Obituary.

JAMES STAATS FORBES.—Mr. J. S. Forbes, the ell-known Chairman and Director of the London, hatham, and Dover Railway, who died at his house ı the Chelsea embankment, on Tuesday, the 5th st., had been a member of the Society of Arts since 73. He was also a Vice-President of the Society om 1889 to 1891. Mr. Forbes was born in 1825, d entered the service of the Great Western Rail-ıy Company at an early age. He was trained under unel as a draughtsman, but his first important pointment was on the staff of the Dutch-Rhenish ailway, of which he became manager. This was English company, which was afterwards bought by the Dutch Government. Besides the Chair-ınship of the Chatham and Dover, and the Metro-litan District Railways, Mr. Forbes was concerned the management of several other railways. He ıs President of the National Telephone Company, d connected with many other public companies. e was well-known for his love of art, and his col-ction of pictures is large and valuable.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

ednesday Evenings, at 8 o'clock:—

APRIL 20.—"Motor Cars for popular use." By ERVYN O'GORMAN, M.Inst.E.E. The Hon. JOHN OUGLAS SCOTT MONTAGU, M.P., will preside.

APRIL 27.—"The Need of Duty-Free Spirit." By THOMAS TYRER.

Dates to be hereafter announced:

"Lessons to be Learnt from the Fire Brigade Appliances at the late International Fire Exhibition." By EDWIN O. SACHS.

"Early Painting in Miniature." By RICHARD R. HOLMES, C.V.O.

"Statistics of the World's Iron and Steel Industries." By WILLIAM POLLARD DIGBY.

INDIAN SECTION.

Afternoons, at 4.30 o'clock:—

THURSDAY, MAY 12.—"British-Grown Tea." By A. G. STANTON.

TUESDAY, MAY 31.—"The Economic and Industrial Progress and Condition of India." By J. E. O'CONOR, C.I.E., late Director-General of Statistics, India.

COLONIAL SECTION.

Tuesday afternoons, at 4.30 o'clock:—

MAY 3.—"Canada and Great Britain." By W. L. GRIFFITH. The Right Hon. the EARL OF ABERDEEN, G.C.M.G., LL.D., D.C.L., will preside.

APPLIED ART SECTION.

Tuesdays, 8 o'clock:—

APRIL 19.—"The Sentiment of Decoration." By ALFRED EAST, A.R.A. WALTER CRANE, R.W.S., will preside.

MAY 10.—"Crystalline Glazes and their Application to the Decoration of Pottery." By WILLIAM BURTON. HENRY H. S. CUNYNGHAME, C.B., will preside.

MAY 17.—"Pewter." By LASENBY LIBERTY. SIR GEORGE BIRDWOOD, K.C.I.E., C.S.I., will preside.

CANTOR LECTURES.

The following course will be delivered on Monday afternoons at 4.30 o'clock:—

PROF. R. LANGTON DOUGLAS, M.A., "The Majolica and Glazed Earthenware of Tuscany." Three Lectures.

LECTURE I.—APRIL 25.—*The Majolica of Siena.*—The early history of the art in Italy—Hispano-Moresque ware—Siena's natural advantages for the production of fine ware—*Terra di Siena*—Sgraffito ware—Progress of the art—The *ambrogette* of Siena—Foreign artists in Siena—Maestro Benedetto—Lustred ware produced in Siena—The decline of the Siena *fabbrica*.

LECTURE II.—MAY 2.—*The Glazed Earthenware of Florence, and the Works of the Della Robbia.*—The early history of the art in Florence—Early pieces of Florentine manufacture—The Della Robbia ware—History of Luca Della Robbia—The art of Andrea Della Robbia—The introduction of variety of colour into Della Robbia ware—Giovanni Della Robbia—The majolica of Florence.

LECTURE III.—MAY 9.—*The Majolica of Montelupo and Cafaggiolo.*—Montelupo an early seat of the manufacture of glazed wares—Its connection with Siena—Lorenzo di Pierfrancesco de' Medici—The Fattorini and the Medici—Cafaggiolo—The history of the villa—Characteristics of the work of the Fattorini—The smaller *fabbriche* of Tuscany—The later history of majolica in Tuscany.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, APRIL 18...Surveyors, 12, Great George-street, S.W., at 8 p m. Mr. Thomas Blashill, "London Streets and London Street Traffic."

British Architects, 9, Conduit-street, W., 8 p.m., Mr. E. S. Prior, "The Statues of Wells Front, with some Contemporary Foreign Examples of Sculpture."

Camera Club, Charing-cross-road, W.C., 8¼ p.m. Mr. E. T. A. Wigram, "The North-Western Province of Spain."

TUESDAY, APRIL 19...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p m. (Applied Art Section.) Mr. Alfred East, "The Sentiment of Decoration."

West India Committee, 15, Seething-lane, E.C., 3¾ p.m. Sir George Watt, "Cotton Improvement."

Royal Institution, Albemarle-street, W., 5 p.m. Prof. L. C. Miall, "The Transformations of Animals." (Lecture II.)

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Mr. John Macdonald Henderson, "Aerial Suspension-Cableways."

Statistical, 9, Adelphi-terrace, W.C., 5 p.m. Mr. William H. Tozer, "Five Years' Experience of the Effect of the Workmen's Compensation Acts, with special reference to Schemes certified thereunder."

Pathological, 20, Hanover-square, W., 8½ p.m.

Zoological, 3, Hanover-square, W., 8½ p.m. 1. Messrs. Oldfield Thomas and Harold Schwann, "Mammals collected during the Uganda Boundary Commission by Mr. W. G. Doggett." 2. Mr. F. E. Beddard, "Contributions to the Anatomy of the Lacertilia.—II. Some Points in the Structure of *Tupinambis*." 3. Dr. P. Chalmers Mitchell, "The Disposition and Morphology of the Intestinal Coils in Mammals." 4. Mr. G. A. Boulenger, "The Characters and Affinities of the Triassic Reptile, *Telerpeton elginense*." 5. Mr. Herbert Druce, "Descriptions of some new Species of Butterflies belonging to the Family *Erycinidæ* from Tropical South America."

WEDNESDAY, APRIL 20...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. Mervyn O'Gorman, "Motor Cars for Popular Use."

Meteorological, 25, Great George-street, S.W., 7½ p.m.

Chemical, Burlington-house, W., 5½ p.m. 1. Mr. A. Scott (*a.*) "The Vapour Density of Hydrazine Hydrate;" (*b.*) "The Combining Volumes of Carbon Monoxide and Oxygen." 2. Mr. S. H. C. Briggs (*a.*) "Ammoniacal Double Chromates and Molydates;" (*b.*) "Double Chromates of the Series $(M'_2 M'' (Cr. O_4)_2)$ 6 H_2O Magnesium and Nickel Compounds." 3. Mr. W. H. Perkin, Jun., "Experiments on the Synthesis of the Terpenes, Part I. Synthesis of Inactive Terpineol, of Dipentene and of Terpin Hydrate." 4. Messrs. F. B. Power and F. Tutin (*a.*) "A Lævo-rotatory Modification of Quercitol;" (*b.*) "The Constituents of the Essential Oil of Californian Laur[el]." 5. Mr. F. H. Lees, "Some Derivatives of Uml[bel]lulone."

Microscopical, 20, Hanover-square, W., 8 p.m. [Ex]hibition of Pond Life.

Entomological, 11, Chandos-street, W., 8 p[.m.] 1. Mr. Frederick Enock, "Nature's Protection [of] Insect Life, illustrated by Colour Photograph[s]." 2. Mr. G. H. Vertall and Colonel Yerb[ury], "Specimens of the Dipterous Families *Stratio[my]idæ* to *Cyrtidæ*."

British Archæological Association, 32, Sackvi[lle-]street, W., 8 p.m.

Ambidextral Culture Society (in the Rooms of [the] Medical Society), 11 Chandos-street, W., 5 p[.m.] Rev. H. J. Dukinfield Astley, "Ambidextry [of] Primitive Man."

THURSDAY, APRIL 21...Cyclists' Touring Club (Metropoli[tan] Section) (at the HOUSE OF THE SOCIETY OF AR[TS], John-street, Adelphi, W.C., 8 p.m. Discussion [on] "Motor Cycles."

Linnean, Burlington-house, W., 8 p.m. Mr. [J.] Cash, "British Freshwater Rhizopoda." Exhi[bi]tions:—1. Mr. Clement Reid, "Drawings by M[rs.] C. Reid of Fruits and Seeds of British Preglac[ial] and Interglacial Plants. II. Calycifloræ." 2. [Mr.] R. Morton Middleton, "Holograph Letter [of] Linndens to Haller, dated from Upoala, 12th M[ay] 1747."

Society for the Encouragement of Fine Arts, [ ] Suffolk-street, Pall-mall, S W., 8 p.m. [Mr.] Wyke Bayliss, "In the House of Her Friend[s]" (Art in relation to the Sanitary Condition of [the] great Cities).

Royal Institution, Albemarle-street, W., 5 p[.m.] Prof. Dewar, "Dissociation." (Lecture II.)

Civil Engineers, 25, Great George-street, S.W[.,] 8 p.m. ("James Forrest" Lecture.) Mr. Dug[ald] Clerk, "Internal Combustion Motors."

Numismatic, 22, Albemarle-street, W., 7 p.m.

Camera Club, Charing-cross-road, W.C., 8¼ p[.m.] Mr. O. G. Pike, "Pictures from Bird Land."

Mining and Metallurgy, Geological Societ[y's] Rooms, Burlington-house, W., 8 p.m. Discussi[on] on "The Equipment of Laboratories for Advanc[ed] Teaching and Research in the Mineral Industrie[s]."

FRIDAY, APRIL 22...Royal Institution, Albemarle-stre[et,] W., 9 p.m. Colonel David Bruce, "Sleepi[ng] Sickness in Uganda."

Civil Engineers, 25, Great George-street, S.W[.,] 8 p.m. (Student's Meeting.) Mr. A. Trewl[...] "No. 2 River-Pier of the Beckton Gasworks."

North-East Coast Institute of Engineers and Sh[ip]builders, Westgate-road, Newcastle-on-Ty[ne,] 7½ p.m. Lieut. E. F. Baker, R.N., "The Mana[ge]ment of Belleville Boilers at Sea."

Architectural Association, 9, Conduit-street, W[.,] 7½ p.m. Mr. W. Gilbert, "Craftsmanship."

Clinical, 20, Hanover-square, W., 8½ p m.

Physical, Royal College of Science, South K[en]sington, S.W., 5 p.m. 1. Sir W. de W. Abn[ey,] "Calculation of Colours for Colour Sensetomet[ry] and the Illumination of 'Three Colour' Phot[o]graphic Transparencies by Spectrum Colours." 2. Prof. J. D. Everett, "Normal Pileing as co[n]nected with Osborne Reynold's Theory of t[he] Universe." 3. Dr. R. T. Glazebrook, "Note [on] the Diffraction Theory of the Microscope [as] applied to the case when the object is in motion." Exhibition of apparatus by Mr. Peter Heele.

SATURDAY, APRIL 23...Royal Institution, Albemarle-stre[et,] W., 3 p.m. Mr. Cyril Davenport, "Cameos."

Antiquaries, Burlington house, W., 2 p.m. Ann[i]versary.

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communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

NEXT WEEK.

Monday, April 25, 4.30 p.m. (Cantor ctures.) Prof. R. Langton Douglas, .A., "The Majolica and Glazed Earthen- ıre of Tuscany." (Lecture I.)

Wednesday, April 27, 8 p.m. (Ordinary eeting.) Thomas Tyrer, "The Need of ıty-free Spirit."

Further details of the Society's meetings will found at the end of this number.

APPLIED ART SECTION.

Tuesday, April 19, 1904; Walter Crane, W.S., in the chair.

The paper read was "The Sentiment of ecoration." By Alfred East, A.R.A.

The paper and report of the discussion will published in a future number of the *Journal*.

CASES FOR JOURNAL.

Some members have expressed a desire to supplied with cases to hold the numbers the *Journal* as they are issued and before volume is completed for binding. The nders have prepared and lettered a box in ok form (Stone's patent box) to match the oth-bound volumes of the *Journal*, which ll contain all the numbers forming a volume. ese boxes can be supplied to members (at charge of four shillings each) on application the Secretary.

Proceedings of the Society.

SEVENTEENTH ORDINARY MEETING.

Wednesday, April 20, 1904; The Hon. John Douglas-Scott-Montagu, M.P., in the chair.

The following candidates were proposed for election as members of the Society :—

Abel, Peter, Usine Ste. Madeleine, Trinidad, British West Indies.
Abrahams, Henry, The British Life Office, Limited, 37, King's-chambers, Angel-street, Sheffield.
Annable, Henry William Coupé, F.C.S., The Tungsten and Rare Metals Company, Limited, Queen's-road, Battersea, S.W.
Boyle, Mrs. Cecil, Avon Carrow, Avon Dassett, Leamington.
Cram, Ralph Adams, care of Messrs. Brown, Shipley and Co., 123, Pall-mall, S.W., and 53, State-street, Boston, Massachussetts, U.S.A.
Crawford-Frost, Rev. William Alfred, M.A., 1900, Green-street, Philadelphia, U.S.A.
Folker, Alfred Henry, 12, Park-road, Harlesden, N.W., and 42, Holborn Viaduct, E.C.
Forga, Alfred, A.M.I.Mech.E., Arequipa, Peru, South America.
Hayford, Casely, Anona-chambers, Axim, Gold Coast Colony, West Africa.
Hethey, G., 33, Chepstow-villas, Kensington, W.
Holloway, Thomas, Newlands, 19, Cedars-road, Clapham-common, S.W.
Kloss, Cecil Boden, Johore Museum, Johore, Malayan Peninsular.
Lennard, Thomas J., Henbury-court, near Bristol.
Lucke, Percy K., Assoc.Inst.M.M., P.O. Box 6342, Johannesburg, Transvaal, South Africa.
Pearson, Frank Loughborough, 3, Langford-place, St. John's-wood, N.W.
Ridgeway, The Right Hon. Sir Joseph West, G.C.M.G., K.C.B., K.C.I.E., 67, Mount-street, Park lane, W.

The following candidates were balloted for and duly elected members of the Society :—

Brinell, Johan A., Chief Engineer, Jernkontoret, Stockholm, Sweden.
Codington, Edmund W., The Polk County National Bank, Bartow, Florida, U.S.A.
Garlick, J., M.L.A., Adderley-street, Cape Town, South Africa.
Haig, Cecil Henry, 7, Eaton-terrace, S.W.
Martin, E. F., Royal Societies Club, St. James's-street, S.W.
Mather, Enoch, A. M., M.D., 80, Park-place Eas Detroit, Michigan, U.S.A.

Pearse, Alfred, 14, Willow-road, Hampstead, N.W.
Phillips, John, A.M.I.Mech.E., Cornubia-house, Carlton-road, Nottingham.
Pote-Hunt, Richard, Plym-villa, Ward-road, Shanghai, China.

The paper read was—

POPULAR MOTOR CARS.

By Mervyn O'Gorman, M.I.E.E.

Public favour has not yet been expressed with such spontaneous unanimity as to justify the title of my paper, but if a car is made sufficiently cheaply, and is designed so as to be popular there is *one further condition* — rightly or wrongly, it must not be called a "freak." Ingenuity which may escape unpunished in a detail like a carburettor or unseen in a lock nut, is unpardonable in the general design. And so we find a dummy bonnet containing a tool-box (or a suit of overalls), a tiller steering disguised with a hand-wheel, a cardan shaft which bends in only one direction, six-hole lubricators of which only two are operative, side chains without distance rods, back axles having one loose wheel but ornamented with an empty differential box, undished "artillery wheels" whose spokes can never be in compression or rims in tension, "balanced" brakes which are thrown out of action if the carriage springs pass over a bump in the road, and lastly "automatic" carburettors which ensure a faulty mixture at all times. What matter the defects if fashion merely requires the vendor to embody in his story some of the mystic words :—"Mercedes bonnet," "Wheel steering," "Direct drive," "Sliding gear," "3-speeds and reverse," "Cardan transmission," "Artillery wheels," "Long wheel base," &c., &c.," together with such other catch words as have become fashionable in the catalogue. This is a regrettable state of things.

In the matter of shapes and words, fashion is the handmaiden of the advertiser. If we hear a property praised with sufficient iteration, we presume it to be worth claiming and a determined preference is thereupon evinced for features which on the great racers are doubtless a means to an end, but many of which must lose any merit they had in their adaptation to 5 or 10 h.p. cars.

It is like using Carlyle's diction without sharing his intellect and temper, or Meredith's style without his wit. Debateable matters on which the public has fixed views may be tab lated as follows :—

Engine :—

(1) Multiple *v.* single cylinders.
(2) Vertical *v.* horizontal engines.
(3) Small enclosed *v.* large fly-wheels.
(4) Racing bonnets and cellular radiat *v.* unobtrusive bonnets and gill tubes.

Frame and Gear :—

(5) Valves in pockets *v.* valves in cylinc head.

Control :—

(6) Spray carburettor *v.* surface wick a others.
(7) Induction supply of gas *v.* pressu supply.
(8) Side chains *v.* direct drive live ax (this fashion has lately received t order of right-about turn).
(9) 4-speed sliding gear *v.* 2-speed of a other type.
(10) Governing by throttling the inlet throttling exhaust, hit and mi altering mixture, &c.
(11) Long wheel base *v.* springs prope damped.
(12) Heavy *v.* light cars (here the turn coming).

Body :—

(13) Ornate carosserie *v.* simple and smoo bodies.
(14) Wheel steering *v.* tiller steering.
(15) Racing results *v.* reliability of trial r sults.

In comparing these competitors for pub favour, it may be useful to premise :—

1. That the following remarks are entir restricted to popular as distinct from hig powered cars, and

2. That they do not indicate a preference any existing manufacture but are the resu of experiments on an experimental car bu from stem to stern in a private laboratory ; a

3. That it is useful to consider particula the less fashionable alternatives, because t others do not lack supporters.

Engine.—Ask the ordinary man what wants from his engine, and he will answ it (if he is a wise ordinary man) : "not to bothered with it !" But it will bother him :

1. If it wastes the seating and lugga space of his car (*i.e.*, it should not occu half the front of the frame).

2. If it does not give power and speed fr

: least amount of iron (*i.e.*, it should be a ;h-speed engine).

;. If it fails to go a long way with the least ount of fuel (*i.e.*, it should have full com- ssion at all speed, and no valve pockets, ., &c., so as to be efficient).

|. If it is not simple to make and mend, eap to buy, and if its troubles are not easily ced (*i.e.*, it should have a single cylinder ly).

;. If it joggles and shakes him (*i.e.*, it uld have a large flywheel, long connecting ls, and the carriage work should be mounted springs).

5. If it requires much gear reduction and uses to travel slowly as well as fast, say m 2 to 20 miles an hour without gear ange.

7. If it does not start easily (which is a estion of ignition, carburettor and valves).

3. If it does not run silently (*i.e.*, it should ve a perfect silencer at will, and normally e no gear reduction).

). If it upsets the car on turning corners e., its weight should be low as in a horizontal gine).

10. If it fails to supply itself with lubricant, ter, and fuel, and do its own repairs (*i.e.*, t want any or a minimum).

11. If it is not completely accessible for ention.

I.—Single Cylinder.

A friend who owned a big car asked at the st exhibition about getting a new one. He d but one stipulation, "it must have only e cylinder; if that cylinder doesn't start, I n't go out, and, therefore, I don't get ught; and if it misses fire, I know at once ere to look for the trouble." "It ought to a good sized cylinder though," he added, an afterthought. I found that he did not nt a popular car, and I did not agree; but r the cheap car when there is no question of irting on the spark, one cylinder wins the y, the more easily that all appreciable en- ne vibration can be eliminated *without* rfect engine balance.

II.—Horizontal Cylinder.

Having as I would suggest, rightly pre- red the cheapness and simplicity of one linder, a compromise must be made between e claims of the various engine positions, to inimise the "bothers" of the ordinary man, d an investigation does not so markedly favour the vertical cylinder for popular cars as current usage would indicate. In some things the vertical engine cannot favourably compare to the horizontal; thus, in facilitating the use of long connecting rods, large flywheels, in securing a low centre of gravity, economy of seating space and slow-running with a view to approaching the direct-drive which means efficiency.

Tabulating the opportunities of the horizontal position, we find that—

III.—Flywheels.

(1) It allows more easily of large flywheels, thus obviating the intermittent effect of a single cylinder,

(2) and therefore admits of slower running; this economising on the weight of the gear the increased weight of flywheel.

(3) It allows of diminishing the obliquity of the connecting rod by using long rods and eccentric cranks,

(4) and this without raising the centre of gravity.

(5) The horizontal position does not *per se* limit the engine speed,

(6) but facilitates the selection of any convenient place for the engine.

(7) Incidentally it makes one more step towards a true direct drive from an engine rotating in the same plane as the road-wheels (I will return to this later),

(8) and allows of putting the water-jacket low enough to make a failure of the water pump less important than if the cylinder were above the radiators.

(9) The horizontal engine may be stored almost entirely under the car frame so as to give great latitude for variations of the carriage work.

IV.—Bonnets.

10. Without any waste of space by a prodigious bonnet.

11. The horizontal position generally gives easier inspection of crank pin bearings, and does not preclude perfect freedom of access to the valves and head (though the grave neglect of accessibility in the past is the chief cause of the disappearance of this type of engine).

I can say that I believe this disappearance to be temporary, and I can quote the Wolseley, Siddeley, Duryea, Winton, Oldsmobile, Cadillac, James and Browne, Roots, Alldays, and others amongst the persevering minority.

V.—VALVES IN THE HEAD.

This title at once recalls a malady of the modern motor which is at the moment spreading a good deal. It is well recognised that the less the inside surface of the combustion space the less is the waste of heat, and in our motoring childhood, when we were free from fashions' fetters, we would have preferred the dome of minimum surface with the valves working in it. In our "de-Dion-days" one small pocket was added for convenience of inspection of both the valves, but now, since the excellent plan of opening the inlet by a cam has come into vogue, we have without excuse abandoned the thermal efficiency of the old design in favour of a purely ornamental symmetry. An engine, like a man, is no better for having a flat head and two thin flat pockets of small capacity and large inside surface, while the evil is aggravated by fitting each pocket with an uncooled inspection plate. Such a design precludes high compression and conduces to self firing.

It is a pleasure to note that the engines designed by Mr. Craig as well as the Duryea, the Clement Garrard bicycle engine, and a number of others are rejecting this innovation.

VI.—AUTOMATIC SPRAY CARBURETTOR.

It is with hesitation that I touch on any experiments on carburettors, because with marked regularity each week produces a new automatic carburettor. Be it noted, however, that no seeker for truth and unpopularity has produced and sold a meter for measuring the degrees of "automaticity." Pictures of carburettors mostly disclose a constricted air-passage into which an ever-increasing jet of petrol is drawn in proportion to the increasing vacuum which results from the increasing rapidity of the stroke of suction as the engine goes faster.

Three evils result from this :—

1. That more petrol is wanted than need be (which does not much matter).

2. That a less total of mixture gets into the engine so that not only its output but also its compression and efficiency are diminished.

3. That what mixture does reach the engine is incorrect (and too rich, with a further inefficiency and extra heating of the engine head).

Two or three cures present themselves :—

1. To make a leak into the partial vacuum by a valve. This is the automatic carburettor.

2. To blow more air in at the entrance.

3. To avoid having any constriction in the air inlet and to supply at each stroke t quantity of petrol required, as a liquid, or dust, or as vapour, or even up a wick.

Partly because the high prices paid f certain cars, notably racers, warrant the e penditure of time and care in accurate adjusting the spring and movement of t "leak" valve, and partly because there is means for the owners of cheaper cars knowi whether such adjustment has been ma properly, the leak valve plan having w started, will run its course. It is a delightfu ingenious and simple device which deserv success, and which I think the world owes an Englishman—Mr. Pidgeon. Neverthele it has to be calibrated to work correctly, a in the absence of any instrument for so doi (other than taking at all speeds B.H.P. of t engine to which it is fitted) the appliances issued on cheap cars are liable to be worse th useless.

Even when the right proportions have wi care been got throughout the range of engi speeds from 200 to 2,000, I am not aware th any correction has been attempted for the gre variation in density of both air and petrol wi ordinary temperatures. Furthermore, a device that draws the petrol by suction out its nook must be rigidly limited as to the weig of fuel taken in per stroke by the pressure supply, which is atmospheric pressure. Th limitation is unfavourable both to getting maximum output from an engine of given si on the one hand and to its fuel efficiency the other.

Following out these views, a carburettor h been made for me on the other principle blowing in the extra air to meet the ext demand. The first effect of this inversion the present system was to abolish one by o the float, the spray, the needle-valve, and, course, the automatic valve, so that in present state it consists of a petrol tank wit pipe blowing air into it from the crank ca through a wick.

VI.—PRESSURE SUPPLY.

The objects to be kept in mind were qualities of a carburettor, and as no claim credit can be made for resuscitating the surfa carburettor, the sketch is given for what may be worth.

The qualities of a petrol carburettor sho be :—

1. To supply always the right quality mixed gases to the engine.

2. To evince no will of its own in the sel

n of the mixture beyond keeping it constant ıen correctly adjusted.

3. To provide for perfect admixture of the nstituents whatever be the proportions lected.

4. To afford no constriction in the free ssage of gases to the engine, *e.g.*, not to use a diminution of the engine compression ıen running fast.

5. To allow for using up the whole of the mmercial petrol as now sold.

6. To provide an explosive mixture at once ıen all is cold on starting.

7. To provide that the gases are unaffected quality or in proportions or in thoroughness admixture, whether the demand be throttled accelerated.

8. To be unaffected by the gradients climbed the car, the jolting received by the car, or e manner in which it may be convenient to tuate the engine valves.

9. To allow of easy regulation for best result view of temperature variations either by and or by using the difference of expansion of etals.

10. To be simple and
   (*a*) To contain no fine pipes or passages which can be clogged with fluff or dirt.
   (*b*) To have few, or preferably no moving parts or valves.
   (*c*) To contain nothing fragile.
   (*d*) To be unable to leak or overflow.
   (*e*) To be extremely cheap.

11. To be such that a poor quality of gas in be burnt in the engine, but supplying ich gas (at will) to the engine under a high essure, so that on the compression stroke it ecomes combustible.

VIII.—Direct Drive.

A direct drive only occurs when there is no eed reduction between the motor and its ork, and the degree of indirectness might be easured by the number of steps through hich the power is transmitted, therefore we ave :—

1. A direct drive with the "hub" electric otor, and nowhere else in the motor car dustry (say 100 per cent. gear efficiency).

2. A direct drive "once removed" where the otor turns in the plane of the wheels, and its eed is reduced through the chain, the relaon of speed being about 4·1 (say 85 per cent. ear efficiency).

3. A direct drive "twice removed" where e motor drives a gear wheel which itself is geared to a chain sprocket and thence to the road wheel (say 72 per cent. gear efficiency).

4. A direct drive "three times removed" where the speed reduction is the same as in 3, but the power transmitted through a right angle (say 69 per cent. efficiency of gear).

5. A direct drive "four times removed" where speed reduction by chains takes place after the power has been transmitted to the train of gear mentioned in 4 (say 58½ per cent. efficiency).

6. A direct drive "five times removed" when an additional pair of wheels is introduced generally before the train of gears in 5 (50 per cent. efficiency).

The direct drive of popular fiction is (4) (3) or (2), or a modification of (4), in which a higher reduction ratio is taken at one step in the bevil or worm so as to admit the first pair of wheels.

The approximate percentages quoted show the enormous value of the direct drive, hence there is no criticism against the popular preference for a closer relationship between the engine and its work, but only against the nomenclature which endears with the title of brother an objectionable second cousin.

IX.—Long Wheel Base.

A long wheel base is not an object in itself, because most, if not all its merits, can be obtained by other means; its advantages are :—

1. The spring effect of the long girder (*a*) as to road-shock; (*b*) as to engine vibration.

2. Accommodation for a roomy tonneau or body, with side entrance, without placing any part of the engine, &c., under the passengers.

3. Diminution of side slip.

4. Steady running (to avoid "bouncing twice in one hole" as it is called).

The drawbacks are :—

1. Increased difficulty in rapidly turning.

2. It does not sufficiently cure side-slip to render non-slip devices undesirable.

3. It is more liable to distortion than a short frame with evil effect on the gear.

4. It adds to weight.

5. It adds to cost of purchase and stable accommodation.

We often forget that a good share of the advantages can be got without the drawbacks, and that a long wheel base is not the only means to the advantages.

(*a*) The spring effect and a slow period of vibration (as compared to the frequency o road shocks) are obtainable by the eas

means of coach springs, on condition they are prevented from bouncing either by a friction damper or an air damper. Resiliency is the bane of spiral springs, which are cheap, but much too efficient, and until air springs have left the experimental stage, coach springs are our best resort as affording plenty of friction between the leaves which thereby help to dissipate the energy of the blow. All springs waste energy, and increase the resistance to travelling (as has I think been proved by experiments on ordinary vehicles when it took more tractive force to move a ton on a well-sprung carriage than on an unsprung cart), but no enthusiast for a long wheel base suggests doing away with springs to save power, so it remains for the designer of a popular car to study the alternative methods of avoiding being personally bounced as a means of expending the energy stored in the springs.

I have made an attempt to secure this result by supporting the entire carriage-work of a car from one line in the chassis, so that the chief movement to be dealt with under these conditions, is a movement of pivotting or rotation about that line, and it would appear that this rotation can be easily controlled or damped. I have not by this means obtained with a 6 ft. 9 in. wheel base and a half-ton car, the comfort of a 9 ft. wheel base with the inertia of 20 cwt. on the springs, but the road-shocks are unquestionably modified into a very pleasant undulating movement. Considering the great difference between the weight of a light car, and that of a couple of passengers, and remembering at the same time the small expense of a separately sprung body, it is surprising that so little has been made of this arrangement, which gives, among other advantages, a means of concealing the irregularities of a single cylinder engine.

If it is legitimate to promulgate a catch word in a paper directed against catchwords, I would suggest "separately sprung body" for the consideration of the buying public.

(*b*) The accommodation obtained by a long base can be got on a short one by an economy of bonnet, though I am disposed to the belief that the really popular car should have its springs and running gear designed for the weight of two persons, with an emergency space for a third, or for luggage, behind.

(*c*) In this type of car, which may often be tended by its owner, easy access to the engine is imperative, and as I have said, this can be got without any waste of space.

(*d*) The diminution of slide-slip which is rightly claimed for the long girder construction loses all its importance when we remember that both long and short cars must, in any event, fall back upon anti-side-slip devices, many of which effect a remarkable cure for this evil, and combine it with protecting the tyres, adding to the efficiency of the brakes, and for speed under 20 miles per hour, with which, at present, we are alone concerned, causing little appreciable loss of power.

Should we succeed in transferring these advantages to the short car, we can add to them the advantage which shortness itself ensures, that of easy handling and rapid turning, for in town we often require to turn within a circle of less radius than a car-length (just as a hansom does), whereas long cars cannot usually turn without backing in any road whose width is less than 30 feet.

It is scarcely possible for me to treat in an equal and detailed manner all the popular prejudices tabulated in the first part of this paper, but my remarks will not have been wasted if I have made it clear that many of the discarded and momentarily unpopular devices might be reconsidered by designers for use on the popular car.

DISCUSSION.

The CHAIRMAN, in opening the discussion, said he felt sure they had all listened with the greatest possible pleasure to a paper which had been singularly able and lucid. Speaking for himself, he had learnt a great deal from the observations of the author. The whole trend of his remarks went to show that they must not discard the results which had been achieved by the early builders of motor cars in quite so hasty a manner as had been done in the past. The paper also showed—and he was sure a great many motorists would agree with what he was going to say—that it was very important that the rules of motor car racing should be revised in order to make racing a useful means of improving the "breed" of cars—if he might so express himself—and not only a means of speed, because desirable as speed was, they wanted the qualities of efficiency, economy, accessibility of parts, and flexibility of engine—qualities which were to a great extent lacking in the motor cars of the present day. After hearing the paper he felt certain they would all realise that the internal combustion engine was still in its infancy, and they would live to see it become a more efficient engine possibly than the steam-engine, with a flexibility almost as great, and certainly without that cumbrous boiler which was an inseparable adjunct to the steam-engine. He also felt quite certain that in the future they might have other things besides

petroleum to deal with as fuel. And in considering any carburetter that point should not be left out of account, especially as the fuels of the future were likely to be heavier rather than lighter. He (the speaker) was interested in the author's championship of the horizontal engine, and he had often wondered why the horizontal engine had fallen into such disfavour. One could not help remembering that since the early days when Daimler invented his engine the gas engine was always horizontal, and it was not until much later when the faster running engine was called for that the vertical became the favourite. When they considered that gas engines were built as high as a thousand horse-power, in some cases with horizontal cylinders, he thought that showed they were too much prejudiced against the use of that particular form of engine, especially when they considered the important point brought out by Mr. O'Gorman that a vertical engine usually transmitted its power through a right angle thereby losing a great deal of efficiency. It had always struck him how much loss there was between the engine and the road wheel, and that was, he thought, really the grossest imperfection that was noticeable at the present time. There was nothing so ridiculous as to think it needed 30, 40, or 50 horse-power to propel a car holding six or eight people at a moderate pace, and capable at the same time of going up a steep hill at the rate of 10 or 12 miles an hour. It showed there must be an enormous amount of loss in the transmission of the power between the engine and the road wheel. He could not touch on all the interesting points raised by Mr. O'Gorman, but he would very much like to hear the opinions of others. In conclusion, he congratulated Mr. O'Gorman on a most interesting paper. It had seldom been his fortune to hear a technical subject discussed in so humorous a spirit, and with so much natural power of lucid explanation.

Mr. Lyons Sampson said he was glad to hear the author champion the cause of the horizontal engine, for he had always thought it had been rather undeservedly put aside in favour of the vertical. He was glad to see that a very large number of British makers were now coming back to the horizontal form. One very great advantage in the horizontal engine, with regard to small cars, was that one could make a two-cylinder engine that was truly balanced, by putting the cylinders opposite, and running on opposite cranks. That could not be done with the vertical engine. Mr. O'Gorman was very much in favour of the single engine. He (the speaker) thought the principal difficulty with the single engine was in getting it to run slowly. In several of the smaller cars in which a single engine was used, if the engine was allowed to run slowly, it made the car jump. He had been on a car with Mr. O'Gorman, which bounded like a deer. Mr. O'Gorman advocated a bye-pass on the exhaust pipes, but he (the speaker) thought for the sake of humanity generally such a thing ought not to be allowed. The right way was to have a proper exhaust box that would stop the sound without creating a back pressure. Then with regard to the large fly-wheel advocated by the author, it was quite possible to carry that too far. When the car was going quickly the action of a large fly-wheel was very marked. He believed that was one of the reasons why so much weight was kept thrown on the front axles of some of the higher speed cars. They overloaded the front wheels to make them bite on the ground, and then sacrificed the adhesion on the back wheels. In the fly-wheel of the new Wolseley racer this would probably be quite enough to have a very marked effect on the steering. With regard to having the valves in the head of the cylinder, he believed that the result of experiments proved that where the valve was placed in a pocket or combustion chamber, a better result was obtained from ignition, that was to say, the contents of the cylinder head and the combustion chamber were ignited sooner than if the spark took place directly in the cylinder head. The automatic valve put on carburettors for obtaining constant compression was first put on the Benz engine, and in that case it was put directly on the cylinder cover, and the air admitted when the engine was throttled went into the cylinder without diluting the charge in the combustion chamber, and gave a remarkably good result. The surface carburettor had been neglected very much. He thought one of the reasons why the surface carburettor did not do as well as it ought to was that a sufficient supply of heat was not added to it. To burn liquid into vapour necessitated a certain amount of heat, and where air was drawn rapidly through the surface of the carburettor and evaporated the liquid, the temperature fell to a very low point. Had the incoming air been warmed to supply the necessary heat, he believed the surface carburettor would have given a very much better result than had been obtained. He quite appreciated the author's remarks on the great loss that occurred in the gearing between the engine and the road wheels, and he hoped that before long they would see in London a means of testing what that loss really amounted to. What the author foreshadowed about the variable gear being made automatic and worked with a governor, would be a very interesting development. The point mentioned by Mr. Scott-Montagu about the density of oil, was a matter that had to be borne in mind in considering any developments of surface carburettors—it would not be so easily evaporised as hitherto.

Mr. Leon Gaster asked whether the author could give some data regarding the actual running and maintenance costs of the motor described, as it was not only the economy of the first cost of the motor which made it popular, but the running and maintenance costs must also be low. Apart from steam, petrol or electricity, alcohol promised to be used very largely in the future for motive purposes, and it would have been useful if the author, with his large ex-

perience, could have included some comparative results. He quite agreed with what the author said concerning the great losses incurred in the use of too many transmissions, which losses ought to be reduced to a minimum.

Mr. SYDNEY MORSE said they were very much obliged to Mr. O'Gorman for bringing up the subject, because he was not only a very able man, but he was independent of all the manufacturers. What was really wanted was a popular motor. He did not think the manufacturers realised that half the pleasure in connection with motors was being able to drive oneself. What Mr. O'Gorman had suggested for variable gear was most important, because when driving in the dark it was almost impossible to get your gear in the right place. If that could be done automatically it would meet a great and recognised want. They wanted to get the most they could out of their motors without being necessarily skilful drivers. He suggested that the pressure carburettor might be pushed forward. He also suggested that it might be desirable to have some trials with the owners driving. It was all very well for skilful drivers like Mr. Edge and Mr. Jarrott to say they got so much out of a motor. What they wanted to know was what the ordinary man could get out of the motor. That depended on the simplicity of the motor and the ease with which you get at the parts and mend them. The motor trade of the country would not be successful if the manufacturers turned their attention only to making motors capable of going at high speeds. They wanted a motor that could easily be repaired, that would come cheap both in original cost and in running, and if Mr. O'Gorman's devices met those requirements he was sure they would meet the popular taste.

Prof. ARCHIBALD SHARP said he was very much struck with the importance Mr. O'Gorman gave to high compression, and he (the speaker) could fully corroborate what he said in that direction. He had himself been making some experiments on high compression with a small motor bicycle, but he had gone about it in a totally different way. He had obtained the high compression by merely diminishing the clearance volume between the piston and the cylinder head. To do that and nothing more on a bicycle engine would land one in great difficulties. The first would be that with the ordinary fly-wheel it would be impossible to run an engine at anything like a slow speed, so the first necessity was to put a more powerful fly-wheel on the engine. The economy in petrol under all conditions, he thought, fully bore out the results shown by Mr. O'Gorman. There was just one other point he wished to say a word or two upon. There were one or two considerations that suggested themselves to him, but he was not putting forward what he was going to say as his own settled convictions. It seemed to him that on the question of the variable gear for a popular car which had to turned out at a price somewhere about £150 £200, the question of variable gear required care consideration. Why not at once duplicate t cylinder? The cost of adding a second cylinder an engine would possibly not be very much great than complicated gear, and further, one wou be able to simplify transmission, and inste of crawling up hill on low gear, with an engine half the power one could rush up a hill at a spe approaching the legal limit. Take for example t popular car constructed to carry two passengers wi a six horse-power engine and a single cylinder th gave a good speed on the level, but to carry t passengers up hill, they had to have a complicat system of gearing. He did not, for a moment, wi to suggest that the two cylinders would be the be solution of the problem, but it was a subject th required a little serious attention.

The CHAIRMAN, in proposing a vote of thanks Mr. O'Gorman, said he had listened with a gre deal of interest to the non-technical remarks of M Moore, who seemed to require, as they all did, a c that would cost nothing, and would accomplish every thing. He (the speaker) was often told by his frien in the House of Commons and elsewhere, that what wa wanted was a car costing about £150, nicely covered in with plenty of horse-power that would carry at lea five or six people, and, of course, it must be capabl of going 200 miles without stopping. He told the that sort of combination could only be purchase for a sum nearer four figures than three. He wa afraid they would not get a car that would answe all their requirements until they reached the moto millennium.

Mr. O'GORMAN, in responding, said there wer reasons why it might not be best to have two cylinder in a cheap car. There must be some gearing. Even i a motor bicycle, which had the assistance of th rider, he still found, at the present time, riders wante gearing, and they would have it. The cheapest form of speed-gearing combined with a clutch need no cost more than the variable gear which he had in his mind. They would each cost about £8, and both combined the clutch, and therefore if they must have gear, and if they could get variable gear instead of step-gear, there was no necessity for a second cylinder, which only introduced complications. With regard to Mr. Sampson's observations, he did take him on a car which Mr. Sampson described at the time as a grasshopper, but the reason why it jumped was because it had nothing which corresponded to a distance rod, so that the pull of the chain was immediately acting upon the springs which at each explosion were compressed and then released, so that the car was inclined to rear up. With regard to the valve in the pocket which Mr. Sampson suggested as having advantages over the valve in the head, he (the speaker) thought they might take the experience

of the Mercedes Company as practically settling the point. In 1902 the two valves were separated by a partition just as in certain American cars; in 1903 that partition was abandoned because it was found unnecessary to isolate the fresh gas and keep it near the spark, and he understood that at the present time this practice was adhered to. He thought that practically settled the point.

Miscellaneous.

RECENT ADDITIONS TO THE ART COLLECTIONS IN THE VICTORIA AND ALBERT MUSEUM.

The English earthenware from the Jermyn-street collection has now been classified and arranged. Among the later additions to the pottery section of the Museum is a drug vase made by Masseot Abaquesne, of Rouen, in the 16th century, presented by J. H. Fitzhenry, Esq. A rare, if not unique, porcelain bowl with decoration in the style of Rhodian earthenware, made at Florence or Pisa, and dated 1638, has been lent by Henry Willett, Esq. The collection of pewter has been enriched by gifts and loans from J. H. Fitzhenry, Esq., and Colonel Croft-Lyons. In the water-colour galleries will be found three bronze statuettes by Alfred Gilbert, R.A. In the same gallery is a replica of Rodin's marble figure in the Luxembourg, Paris, "La Danaïde," lent by Gerald Arbuthnot, Esq.

At the end of the Prince Consort Gallery, near the collection of illuminated manuscripts recently given by Mr. George Reid, two additional cases of manuscripts are now shown for a short time. Eleven of these are lent by Mr. Wyndham F. Cook; the others are from the collection in the National Art Library. Those belonging to Mr. Cook are of the 15th and 16th centuries. Prominent among them are a fragment of a northern French book of hours, of the end of the first half of the 15th century, and a German manuscript of the 16th century.

The seven manuscripts from the library collection include a beautiful missal from the monastery of St. Denis, near Paris, of the first half of the 14th century, a Persian Koran of the middle of the 17th century, and a German 12th century Psalter, with one other French manuscript, two Italian MSS., and a Dutch one. Close by are three cases containing original drawings, the work of modern English book-illustrators. Phil May is represented by a characteristic study on brown paper, and by several pen-and-ink drawings for process reproduction in *Punch* and elsewhere. Near them are two pen-and-ink drawings by Charles Keene, reproduced by wood-engraving in *Punch*. G. Du Maurier's original pencil studies and finished pen-drawings for *Punch* are exhibited along with proofs of the wood-engravings. The work of Frederick Barnard is illustrated by three characteristic drawings in pen-and-ink. There are also four mounts containing nine original water-colour drawings by Kate Greenaway, made for her well-known picture-books.

In the Furniture Section are two carved wood coffers of Tyrolese and South-German work dating from about 1500, of a style scarcely represented hitherto in the Musum collection; also an oak bed-front from the North of Europe, probably 17th century work.

Amongst the vestments exhibited in the East Cloisters of the North Court will be found two interesting dalmatics and a chasuble of the later years of the 15th century, which are said to have come from the Church of St. Severin, at Cologne; they are of stamped woollen velvet with embroidered orphreys. In an adjoining case is a mauve coloured velvet cope, decorated with appliqué work and embroidery; on the hood is represented the Virgin and Child, whilst Our Lord in glory appears in the middle of the orphrey, with St. Peter, St. Bartholomew, and St. Ursula to the right, and St. Paul, St. John the Evangelist, and St. Andrew to the left, beneath canopies. This splendid example of ecclesiastical embroidery is German work of the early 16th century.

At the end of the South Court, in a case facing the lace collection, is an altar-frontal in three panels, which is a characteristic piece of Flemish pillow lace of the 17th century, with bold scrolling patterns united by brides' picotées.

Some Tudor tapestry hangings, which for many years were on the walls of the audit room of Winchester College, have been lent by the Warden and Fellows of the college, and are exhibited in the Tapestry Court. Two of these hangings form part of a tapestry of great beauty and are unusual in design. The field is in broad vertical stripes of red and blue covered with a pattern, over which are the following devices repeated:—The Sacred Monogram, red and white roses, and shields azure, three crowns or.

The central portion of the tapestry is missing, but a detached fragment bearing the Agnus Dei evidently belonged here. The combination of the red and white roses probably refers to the union of the two rival houses under Henry VII. and his queen, Elizabeth of York. It is an interesting fact that their eldest son Arthur, the first prince who united the claims of the two houses, was born at Winchester in the year 1486. The tapestry dates from the latter years of the 15th century.

Two other examples form portions of a large tapestry which had for its subject the story of David and Abagail. The tapestry is a Flemish production of the second half of the 15th century.

In the Indian Section of the Museum is an interesting collection of personal ornaments worn by native women, chiefly bracelets, armlets, anklets, and toe-rings in white metal and brass: for the most part they were found in Central India and the North-West Provinces. They are the gift of Miss E. M. Herbert Wright.

GAME CENSUS OF THE BRITISH CENTRAL AFRICA PROTECTORATE.

The Society of Arts have been favoured with permission from the Secretary of State for Foreign Affairs, to publish the following game census, which is covered by the letter to Sir Clement Hill, K.C.M.G., C.B., Superintendent of African Protectorates, from Sir Alfred Sharpe, K.C.M.G., C.B.

DEAR SIR CLEMENT,—Before I left British Central Africa for England on leave last year, I requested all the collectors of the Protectorate to fill in forms for the obtaining of something in the way of a "Game Census." This has been done, and I now forward it to you. While, of course, many of the items entered are extremely uncertain, the general proportions in which game of different descriptions is present in various districts are fairly reliable. I should put the number of elephants at more like 1,500 than 600.

Yours sincerely,

ALFRED SHARPE.

The Residency, Zomba,
British Central Africa,
January 25th, 1904.

BRITISH CENTRAL AFRICA PROTECTORATE GAME CENSUS, PREPARED FROM STATISTICS SUPPLIED BY DISTRICT COLLECTORS.

Species.	Total.	Port Herald, L. Shire.	Ruo.	West Shire.	Blantyre.	Mlanje.	Zomba.	Upper Shire.	South Nyasa.	South Angoniland.	Marimba.	West Nyasa.	North Nyasa.
Elephant	605	...	7	7	...	...	51	40	50	200	...	50	200
Rhinoceros	124	...	4	1	...	...	20	20	4	5	15	5	50
Gnu Wildebeest	168	...	...	...	...	60	68	40	...	...	...	...	...
Hippopotamus	2,687	20	12	30	500	25	80	100	200	500	200	20	1,000
Zebra	3,665	20	400	75	250	200	170	500	500	200	200	150	1,000
Sable	3,065	60	100	110	200	300	445	500	600	500	200	50	
Roan	1,600	...	...	...	...	...	...	...	...	350	200	50	1,000
Kudu	2,280	10	20	15	150	150	235	500	700	100	200	...	200
Colobi or other Fur Monkeys	7,200	200	...	...	2,000	3,000	...	...	1,000	1,000	...	...	...
Aard Varks	50	...	...	...	...	...	...	...	...	50	...	...	...
Serval	3,300	...	...	...	2,100	1,000	...	...	100	200	...	...	...
Cheetah	...	...	...	...	...	...	...	...	...	...	...	...	...
Smaller Monkeys	15,300	1,000	...	...	...	10,000	...	...	2,000	2,000	300	...	...
Marabous	2,910	500	100	...	50	300	560	200	500	...	200	500	...
Egret	3,200	...	...	...	...	500	...	200	1,000	1,000	500	...	...
Antelopes	2,760	500	...	160	...	1,000	...	...	1,000	100	...	...	...
Chevrotains	...	...	...	...	...	...	...	...	...	...	...	...	...
Wild Pig	9,300	...	100	200	...	2,000	200	500	...	...	3,000	300	3,000
Smaller Cats	4,760	100	...	160	...	2,000	...	...	500	1,000	1,000	...	...
Jackal	4,600	...	...	...	...	...	...	...	2,500	1,000	1,000	100	...
Warthog	7,080	500	100	30	500	200	150	500	1,000	900	1,000	200	2,000
Bush Pig	9,930	500	...	...	2,000	...	400	200	800	3,000	1,000	30	2,000
Hartebeest	14,400	200	300	100	2,000	1,500	1,050	1,000	2,500	1,500	3,000	50	1,200
Impala	5,175	...	200	25	500	...	150	2,000	800	500	...	...	1,000
Reedbuck	21,720	300	500	20	2,000	3,000	1,600	500	800	3,000	6,000	1,000	3,000
Duiker	15,640	...	100	40	2,000	5,000	1,000	500	1,000	1,000	4,000	...	1,000
Klipspringer	2,315	...	15	...	100	1,000	400	100	300	300	...	...	100
Steinbuck	430	...	...	...	...	...	430	...	...	...	...	...	...
Waterbuck	17,200	500	1,500	60	300	1,500	290	1,000	2,000	2,000	6,000	50	2,000
Bushbuck	10,580	1,000	200	80	1,500	2,000	...	500	400	300	3,000	100	1,500
Puku	800	...	...	...	...	...	...	...	...	300	300	...	200
Leche Waterbuck	...	...	...	...	...	...	...	...	...	...	...	...	...
Inyala	20	...	20	...	...	...	...	...	...	...	...	...	...
Lion	543	10	60	25	30	30	18	20	50	100	100	...	100
Leopard	1,751	100	60	25	100	250	46	50	100	400	300	20	300
Hyena	3,850	500	...	120	200	250	80	500	100	1,000	600	...	500
Wild Dog	530	...	...	130	...	...	...	...	300	100	...	...	...
Porcupine	300	...	...	...	...	...	...	...	...	300	...	...	...
Buffalo	740	...	200	...	20	...	60	60	50	150	...	...	200
Eland	7,760	...	100	90	500	100	170	1,000	1,500	1,500	...	800	2,000
Fox	1,000	...	...	...	...	1,000	...	...	...	...	...	...	...
Kadumba	2,500	...	...	...	500	2,000	...	...	...	...	...	...	...

Correspondence.

RAMIE, RHEA, OR CHINA GRASS.

I think it will serve a useful purpose if members of the Society are enabled to judge in a practical manner what the actual present business prospects for the above fibre are.

The knowledge available respecting the choice of climate and of soil, also concerning the cultivation of the plant, the decortication of the green stems, the degumming and softening of the fibre, the preparation, combing, and spinning of the yarn may now justly be termed up to date.

A large number of persons and companies have for many years been making experiments, conducted with more or less knowledge and intelligence, and generally with considerable loss of money and time; the results taken as a whole have, however, shown distinct progress, and have led to a great increase of skill and experience in the practical cultivation, treatment, and manufacture of the fibre in all its branches.

It is now a feasible matter to engage successfully in the cultivation of ramie, in the degumming, spinning, and weaving of ramie commercially without running the risks of the losses of money and time which were inevitable say 10 to 30 years back. Consequently this grand fibre, the splendid qualities of which have been in a large degreee one cause of its slow progress, is now increasingly available for a great variety of purposes.

It has been amusing to me during the last two or three years, to receive communications and visits from many would-be inventors, offering for sale newly invented machines for decorticating ramie, and newly invented processes for degumming and softening ramie, who were mostly under the impression that good decorticating machines and practical degumming and softening processes were non-existent. Such inventors are generally of opinion that the main reason for the slow progress of ramie is to be found in the want of knowledge how to treat it.

Cultivation.—It is now as easy to choose plots of land for successfully growing ramie, as it is to choose suitable plots for growing cotton, hemp, or flax. The nature of the climate and of the soil, the surrounding conditions, the supply and degree of moisture, &c., favourable to the growth, are now well known. Likewise, the mode of forming successful nurseries for the young plants, the system and conditions of planting, the treatment of the plants, the propagation, the cutting of the stems, &c., present no difficulties.

Decortication.—May I explain to those members of the Society who are not quite familiar with the term, the meaning of decortication? The interior of the green stems consists, in a great measure, of woody pith, called in the trade "shieve." This has to be removed by decortication, and also the outer skin of the stems generally termed "pelicule." This skin must be removed in the green state from the underlying fibres, because if allowed to dry it becomes brown and sticks with extraordinary tenacity, by means of a special gum, to the fibres.

Ramie, partially or imperfectly decorticated, needs not only a longer, but also a stronger process of degumming, involving extra cost, extra loss of weight in degumming, and a deterioration in the quality of the filasse. A good decorticating machine must therefore do its work efficiently, give a good production, and be capable of working by means of native labour. Fibre of good quality when decorticated, contains about thirty per cent. of its weight in gum, to be afterwards removed in the degumming process.

The cultivation of ramie has been undoubtedly seriously retarded for many years past through the defective construction of the decorticating machines on the market, and their unpractical working. Some of them performed the process imperfectly; some wasted a great deal of the fibre by breaking and bruising it; others produced too small a quantity, &c.

Whilst I am not able to say that perfection in decortication has been reached, I am able to state that a few decorticating machines are proving successful, notably the last one which the late Mr. Faure invented. To him all growers of ramie are much indebted, because as soon as he realised the great importance of having good decorticators for ramie, he, like a practical engineer, not only set to work to invent one, but he also started a plantation of ramie on his country estate near Limoges in France. He invented several machines, each one better than the previous one, and was able to test them practically with his own green stems; he gained several gold medals, and his latest improved machine is admitted to be the most successful one now at work.

Degumming.—An opinion seems to be prevalent that the process of degumming is still in its infancy, and capable of great improvements. Such is not the case. The principle of freeing ramie fibre from the gum is well understood. Recent improvements have been mainly directed with great success towards shortening and improving the process and reducing the cost. Good quality ramie can now be degummed at a cost of 1¼d. per pound, calculated on the dry weight of the degummed filasse. Inferior qualities of fibre cost 1½d. to 1¾d. per pound. These figures cover labour, materials, steam, water, expenses, &c.

Some growers of the fibre think it is incumbent on them also to degum the fibre. This is, however, a great mistake, because ramie spinners insist on degumming all their fibre themselves, so as to avoid serious losses which might easily be incurred by using fibre degummed by others by means of chemicals and processes deleterious to the fibres. There is no market for the sale of degummed fibre.

Successful degumming involves not merely speed and economy in the process, but also the retention of

the leading qualities of ramie. Its marvellous strength must not be impaired. Its silk-like lustre must not be affected. Its softness must be retained, likewise its efficiency for passing very quickly and easily, with the least possible waste, through the various processes and machines. Its extraordinary wearing qualities and its freedom from rotting when left in water must also be preserved.

Formerly the fibre was not sorted previous to degumming. The consequence was that qualities needing 12 hours for the degumming process were mixed up with qualities requiring 18 hours' treatment, and with both these were mixed up qualities requiring even 48 hours' treatment. Thus, in treating all together, some portions were overdone, others underdone, and the result disastrous in many ways.

In modern Ramie works the fibre is always very carefully assorted, green and white separated, also different qualities and lengths. In this way each lot can receive the degumming and softening treatment specially adapted to its requirement, with the result that the best qualities of filasse obtainable from the raw material are produced and made ready for passing into the machines.

The preparing, combing, and spinning of the fibre are also well understood. New machines have been constructed embodying many special adaptations to the peculiarities of the fibre. The consequence is that it is possible to start ramie spinning mills with the same ease and prospect of success with which cotton and flax mills are started. The combing operations are of primary importance, because of the great diversity in the lengths of the fibre.

The term "long fibre" includes fibre from 8 to 14 inches long; the term "medium fibre" includes fibre from 4 to 8 inches long; the term "short fibre" includes fibre from 1½ to 4 inches long; the term "noils" includes the shortest fibre, say, from ½ to 1½ inches long.

This diversity in the lengths of the fibre involves the necessity of having drawing frames, roving frames, and spinning machines specially constructed for the various lengths of fibre, and it is this skilful adaptation of the construction of the machines to the various kinds and lengths of fibre which is one of the main causes of the great progress made in recent years.

Instead of using, as was formerly the case, machines constructed for worsted, for flax, or for silk waste, specially constructed ramie machines are now in use, with the result that both as regards quality, quantity, and cost of production, the modern machines have put the old experimental machines entirely in the shade.

I may here mention that the noils, that is to say, the short fibre resulting from the combing process and amounting to about 30 per cent. of the weight of the filasse, are so very much sought after, not only for spinning but also for mixing with short wool used in the manufacture of ordinary woollen cloths, that they now fetch more than three times the price they formerly did. At one time it was difficult to obtai[n] 2d. per pound for the noils. They now sell freely a[t] 7d. per pound, which is considerably more than th[e] cost price of the filasse.

The waste in the preparing and spinning opera-tions has through the many improvements intro-duced in the treatment and in the machinery, bee[n] reduced to a minimum. It is now not one-third o[f] what it used to be, and this waste sells for the sam[e] price as the noils.

Increasing Commercial Value.—There seems to b[e] good evidence that an important boom is at hand [in] connection with this fibre. After long years of wai[t]ing the success is in sight, and the cause is due to th[e] fact that ramie has at last been enabled to prov[e] itself a marvellous fibre *commercially.*

It is being used in the manufacture of a great man[y] kinds of textile goods for a great variety of purposes such as ladies' dress goods, muslins, upholster[y] goods, napery (tablecloths, napkins, sheets, &c.) damasks, laces, hosiery, ribbons, scarves, trimming[s] smallwares, mosquito nets, fishing nets and line[s] shoe thread, boot laces, surgical bandages, lint, fir[e] engine hose, sailcloth, &c. It is also now bein[g] largely used in trades for which up till quite recent[ly] it was not supposed to be adaptable. For instance:

Incandescent Gas Mantles.—There are now [in] Germany alone 11 manufacturers of these mantles all using ramie yarn which has shown itself by f[ar] the best yarn for the purpose. For *gentlemen[s'] underclothing and hosiery*, ramie yarns have prove[d] themselves to be of immense value in the manufa[c]ture of these goods; wherever introduced their u[se] spreads rapidly.

For *mixing with worsted, with silk waste, &c.* ramie is now being very extensively used. Th[e] ramie, in the form of sliver, is mixed with slivers [of] the other materials, and drawn and roved. Th[e] yarns spun therefrom have developed qualities whic[h] the unmixed materials did not possess, and here l[et] it be said that ramie is not an adulterant for the[se] other textiles. It imparts qualities to the mixtur[e] which no other fibre can impart. For instance, yar[n] composed of silk-waste and ramie fetch a high[er] price than if composed of silk-waste only, becau[se] the ramie imparts to the silk a wonderful streng[th] and quality, enabling it to be spun exceedingly fin[e] and the lustre of the ramie combines well with th[e] lustre of the silk.

Fancy goods made from a mixture of long-combe[d] wool and ramie possess qualities which are renderin[g] them increasingly fashionable in the market.

We have thus under our consideration in ramie—

A splendid fibre whose qualities place it at th[e] head of all fibres.

A fibre obtainable and saleable in any desire[d] quantity.

A fibre capable of being manufactured into a[n] immense variety of goods with great success.

A fibre the yarns of which can be spun to a[ny] degree of fineness and dyed to any colour. They a[re]

such immense demand by manufacturers, that ginners cannot keep pace with the demand.

A fibre in ever-increasing favour with the public, with the prospect of its becoming the centre of a very large and wide-spread boom.

THOMAS BARRACLOUGH.

20, Bucklersbury, London, E.C.

COTTON GROWING IN THE BRITISH EMPIRE.

Sir R. HAMILTON LANG, K.C.M.G., writes :—

The recent discussion on cotton-growing, which I have just read in the *Journal* of the 8th instant, recalls to my mind an interesting experience which I made in the sixties, and if I venture to allude to it, it is because I think it may be useful to those who are now devoting themselves to the study of a question, the vital importance of which to England cannot be exaggerated.

In 1862, when acting Vice-Consul in Cyprus, I received, through the Foreign Office, the appeal of the Cotton Association of Manchester to extend the growth of suitable quantities of cotton, of which, as a consequence of the Civil War in America, Lancashire stood greatly in need. The cause engaged all my sympathies, but, in the hopelessness of finding anyone in the island to take up the matter seriously, I was forced to act on the saying "to do a thing well, do it yourself." Cotton had for centuries been grown in Cyprus; indeed, Lewis Roberts, in his "Treasure of Traffic," published in 1641, says "The Manchester weavers buy cotton wool in London that comes first from Cyprus and Smyrna, and at home work the same and perfect into fustians, vermillions, dimities, and other stuffs." But the staple of Cyprus cottons, although very strong, is short, and its condition as shipped has all the defects of most of Indian cottons. The crop is plucked from the fields in its pods, which do not open sufficiently to permit of the cotton wool alone being gathered. Sacked and piled in the pods, the condition of the cotton is deteriorated by particles of pod and leaf adhering. I have never been in India, but those who have may be able to say whether most of the cottons there are not also gathered in the pod. In the more highly-developed qualities from American or other seeds, the pod opens so fully that in the fields only the wool is gathered and the pod is left on the stem. Thus a first and chief cause of defective conditioning is obviated.

I rented ten acres of cotton-growing land and planted them with the New Orleans seed which the Cotton Supply Association had sent me. My bailiff was a Nubian who, some thirty years before, was imported into the island as a slave. All I did to the cultivation was to provide first class bullocks, the best type of native plough, and enjoin exceptional care in hoeing and weeding. The soil was only second-class, the fields were not irrigated, but they were what the Greeks call "Livadia," which retain sufficient moisture to bring the plants through the great heat of summer. The experiment was highly successful. The plants grew taller than those of the native type, the cotton was gathered out of the pod, the yield was large, and when the produce reached Liverpool it was classified as worth only five per cent. less than middling Orleans grown in America. The profit was large, for the prices then ruling were high, although not more than the "benefactor" Sully established for cotton only a few months ago. This success led me to rent the whole farm, of about 700 acres, of which, however, only 60 acres were cotton-growing lands. Growing only American cotton, I was able to avoid the deterioration, by hybridization, from proximity to native plants. Deterioration I also prevented by a "wrinkle" from America which I got. In gathering the crop, half-a-dozen women preceded the others and plucked from only the finest and best developed pods. Their gatherings were kept and ginned apart and the seed preserved for future planting. This maintained my standard of quality. The expedient was very simple. I constantly recommended it to others, but it is an example of the indifference of the native mind to small details, that none but myself adopted it. They preferred to pay twice the price for my seed than do the operation themselves. Some ten years after I left the island, I was asked to provide fresh seed from America, as the quality had greatly deteriorated, simply because no one continued to keep up the selection. All exotic seeds will go back to the native unless invigorated by selection. After a great deal of trouble, I obtained from America several tons of seed which I sent to Cyprus, but I never heard what became of them, nor was I repaid for their cost.

The question of ginning presented an immediate difficulty. The native cotton adheres firmly to the seed, whereas the American and other highly-developed qualities separate from it with ease. The little native gins lacerated the staple and were otherwise entirely unsuited. I procured from Messrs. Plott, of Oldham, large gins adapted to American cottons, and when I left the island I must have had 20 such gins at work by steam. An Italian landowner erected another ginning factory whose gins I procured for him from the same firm.

The price of cotton naturally fell on the cessation of the American Civil War, but my yield per acre increased, and even at 6d. per lb., which was about the price when I ceased the cultivation in 1873, cotton was still the most profitable crop of the farm.

What precedes, leads me to the conclusion that, properly gone about, Indian cottons may certainly be greatly improved by planting from New Orleans seed, and that, more quickly than by labouring to improve the native type. I agree with Sir George Birdwood that we have no need to teach the natives how to cultivate cotton. What we have to do is to supply them with good seed, keep up its quality by selection, and place at their disposal the gins adapted to the more highly-developed

staples. A most useful stimulant would be to contract to purchase the produce from the new seed, when delivered to the ginning factory, at say 15 per cent. above the price of native qualities on similar soils. I would even go farther, and recommend a system adopted with great success by an Administration in Egypt with which I was connected, to encourage the growth of sugar canes. We ploughed the land by steam ploughs, we supplied the seed, we made cash advances as the plants progressed and deducted all, as well as the rent, from the crop when delivered to the factory, the price having been fixed beforehand at the time of making the contract. The facility of ploughing the land may not be possible in India, but the other conditions would powerfully attract the impecunious "ryot" and deliver him from the blood-sucking of usurers. Thus encouraged, my impression is that not only may India grow the quality of cotton which Lancashire desires, but, in a decade, her production may be doubled.

One word more and I am done. I tried Sea Island cotton seed and obtained its staple, but I found that the weight of the crop per acre was greatly inferior, and that although I got a higher price per lb. I scarcely gained as much per acre.

The Grove, Dedham,
11th April, 1904.

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday Evenings, at 8 o'clock :—

April 27.—"The Need of Duty-Free Spirit." By Thomas Tyrer.

May 4.—"Statistics of the World's Iron and Steel Industries." By William Pollard Digby.

May 11.—"Early Painting in Miniature." By Richard R. Holmes, C.V.O.

Indian Section.

Afternoons, at 4.30 o'clock :—

Thursday, May 12.—"British-Grown Tea." By A. G. Stanton. The Right Hon. Lord George Hamilton, G.C.S.I., M.P., will preside.

Colonial Section.

Tuesday afternoon, at 4.30 o'clock :—

May 3.—"Canada and Great Britain." By W. L. Griffith. The Right Hon. the Earl of Aberdeen, G.C.M.G., LL.D., D.C.L., will preside.

Applied Art Section.

Tuesday evenings, 8 o'clock :—

May 10.—"Crystalline Glazes and their Application to the Decoration of Pottery." By William Burton. Henry H. S. Cunynghame, C.B., will preside.

May 17.—"Pewter." By Lasenby Liberty. Sir George Birdwood, K.C.I.E., C.S.I., will preside.

Cantor Lectures.

Monday afternoon at 4.30 o'clock :—

Prof. R. Langton Douglas, M.A., "The Majolica and Glazed Earthenware of Tuscany." Three Lectures.

Lecture I.—April 25.—*The Majolica of Siena.*—The early history in Italy—Hispano-Moresque ware—Siena's natural advantages for the production of fine ware—*Terra di Siena*—Sgraffito ware—The *ambrogette* of Siena—Foreign artists in Siena—Maestro Benedetto—Lustred ware produced in Siena—The decline of the Siena *fabbrica.*

MEETINGS FOR THE ENSUING WEEK.

Monday, April 25...SOCIETY OF ARTS, John-street, Adelphi, W.C., 4½ p.m. (Cantor Lectures.) Prof. R. Langton Douglas, "The Majolica and Glazed Earthenware of Tuscany." (Lecture I.)
Geographical, University of London, Burlington-gardens, W., 8½ p.m.
Actuaries, Staples-inn Hall, Holborn, 5 p.m.
Camera Club, Charing-cross-road, W.C., 8.15 p.m. Mr. S. W. E. Schrivell, "In a Kentish Hop Garden."
Medical, 11, Chandos-street, W., 8½ p.m.
Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p.m. Mr. F. G. Fleay, "Old Testament Chronology."

Tuesday, April 26...Optical Society (at the House of the Society of Arts), John-street, Adelphi, W.C., 4 p.m. Meeting to organise an Optical Convention.
Royal Institution, Albemarle-street, W., 5 p.m. Prof. L. C. Miall, "The Transformations of Animals." (Lecture III.)
Designers, Clifford's-inn Hall, Fleet-street, E.C., 8 p.m. Mr. Starkie Gardner, "Lead Architecture."
Medical and Chirurgical, 20, Hanover-sq., W., 8½ p.m.
Civil Engineers, 25, Great George-street, S.W., 8 p.m. Annual General Meeting.
Photographic, 66, Russell-square, W.C., 8 p.m. Mr. F. C. Tilney, "The Artistic Aspect of Photography."
Anthropological, 3, Hanover-square, W., 8½ p.m.

Wednesday, April 27...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. Thomas Tyrer, "The Need of Duty-Free Spirit."
Geological, Burlington-house, W., 8 p.m.
Royal Society of Literature, 20, Hanover-square, W., 4½ p.m. Annual Meeting.
British Astronomical, Sion College, Victoria-embankment, E.C., 5 p.m.

Thursday, April 28...Royal, Burlington-house, W., 4½ p.m.
Antiquaries, Burlington-house, W., 8½ p.m.
Royal Institution, Albemarle-street, W., 5 p.m. Prof. Dewar, "Dissociation." (Lecture III.)
Electrical Engineers, 25, Great George-street, S.W., 8 p.m. Messrs. C. H. Merz, Member, and W. McLellan, "Power Station Design."
Camera Club, Charing-cross-road, W.C., 8½ p.m.

Friday, April 29...Royal Institution, Albemarle-street, W., 9 p.m. The Dean of Westminster, "Westminster Abbey in the 17th Century."
Zoological, 3, Hanover-square, W., 4 p.m. Annual Meeting.

Saturday, April 30...Royal Institution, Albemarle-street, W., 3 p.m. Mr. Cyril Davenport, "Jewellery."

Correction.—Page 473, col. 1, line 1, *for* Rev. Richard Addy *read* Rev. Richard Abbay.

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FRIDAY, APRIL 29, 1904.

ll communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

NEXT WEEK.

MONDAY, MAY 2, 4.30 p.m. (Cantor .ectures) PROF. R. LANGTON DOUGLAS, I.A., "The Majolica and Glazed Earthen- are of Tuscany." (Lecture II.)

TUESDAY, MAY 3, 4.30 p.m. (Colonial ection.) W. L. GRIFFITH, "Canada and reat Britain."

WEDNESDAY, MAY 4, 8 p.m. (Ordinary leeting.) WILLIAM POLLARD DIGBY, "Some tatistics of the World's Iron and Steel In- lustries."

CANTOR LECTURES.

On Monday afternoon, 25th inst., Mr. R. .ANGTON DOUGLAS, M.A., delivered the first cture of his course on "The Majolica and lazed Earthenware of Tuscany."

The lectures will be published in the *Journal* uring the autumn recess.

LISTS OF MEMBERS RESIDING ABROAD.

Lists of members resident abroad have been repared, and can be obtained by members on pplication to the Secretary.

The following lists have been printed :—

. Members Resident in India, Persia, China, Japan, the Malay Archipelago, &c.
. Members Resident in Africa.
. Members Resident in Australasia and Polynesia.
. Members Resident in the Dominion of Canada and Newfoundland.
. Members Resident in the West Indies and British, South, and Central American Colonies.
. Members Resident in the United States of America.
. Members Resident in South and Central America and Mexico.
. Members Resident on the Continent of Europe.

Proceedings of the Society.

COLONIAL SECTION.

Tuesday afternoon, April 12th; The Right Hon. EARL GREY, in the chair.

The paper read was—

THE REGENERATION OF SOUTH AFRICA.

By BEN. H. MORGAN.

I am afraid that the words South Africa have not to-day an altogether pleasant ring to the ears of the everyday, stay-at-home Briton. Let me say at once that such a feeling is only natural, but let me also add, that it is, like many other natural emotions, quite unreasonable. There is a section of the British public which knows only of South Africa that it is a land producing, though at some cost, gold and precious stones, a parched treeless country inhabited by millions of black men and by a handful of whites, about sufficient to populate a decent-sized European capital, a goodly proportion of the superior race being engaged in agricultural work, pursued in leisurely and old-world style. This conception of South Africa as it exists to-day, in the main is not incorrect, and yet the conclusion to which it would naturally lead, to wit, that this is a land without a future, would be totally erroneous. South Africa, won for this country by the polity and valour of generations of great Englishmen, of which the soil has been watered by the blood of thousands of Britain's bravest sons, is a land of immense natural wealth, the exploitation of which has been retarded by racial conflicts, at times by official supineness, at other times by the errors of adminstrators, and yet again by those long fits of indifference which seem constitutional in the stay-at-home Briton. But I hope to show that South Africa is only waiting to be regenerated by the free use of British capital, and, above all, by the liberal application of British brains.

It may freely be admitted that of late South African affairs have not tended to win the regard of the investor and man of affairs at home. The proposal to introduce Chinese labour in the Transvaal and Rhodesia has offended many honest British prejudices, call them convictions if you will; the dictatorial

tone assumed by the South African shipping "Ring" or "Conference" (recently strengthened by the absorption of the only competing line) has justly alarmed and offended commercial men; the undisguised reluctance of South African banks and manufacturers here to give credit to South Africa has naturally caused anxiety in business circles, an anxiety which has not been allayed by the failure of the Transvaal loan. But there are difficult crises in the lives of all young men, and as a civilised country South Africa is very young. What that colony requires of us in the old country is sympathy, occasionally advice, at times help, and at all times intelligent comprehension. I would say to all business men who feel any concern in the future of South Africa, study the land and its resources on the spot if possible, but above all, keep from your eyes the distorting glasses of politics. I am no politician, but like other British citizens, the daily papers, with their columns of political speeches, are before my eyes, and it is impossible not to feel grief that certain politicians, possibly well meaning, should lay themselves out, apparently of set purpose, to belittle South Africa and disparage those who have laboured in sincerity for its welfare, whatever error of judgment they may have committed. I am afraid that the political pamphleteer and the hustings orator have, between them, sown broadcast misconceptions on South African affairs. Unhappily these misconceptions are not confined by any means to the people who listen open-mouthed to the glib patter of tub orators. Many men of standing in the City, of good repute on the exchanges of this great commercial land, have the haziest notions as to the actual resources and present needs of South Africa. In short, John Bull, after settling a long bill for the war which gave him undisputed possession of the Transvaal and of the Orange River Colony, has begun to ask himself whether he has not paid too much for these bits of real estate. This is only natural, but it is in the established order of things that a strong swing of the pendulum in one direction should be followed by an equally marked oscillation in the opposite sense. Extravagant expectations of the economic value of the new territory have inevitably been followed by an all too pessimistic view of the South African outlook. I trust that a calm and dispassionate analysis of the real resources of these broad lands, of the actual conditions of existence there, and a review of the most crying commercial needs of the situation, may brin[g] conviction even to the inveterate "Litt[le] Englander" that in the two new South Africa[n] colonies the British crown has received tw[o] gems of great price.

The War and After.

New South Africa dates from the protracte[d] and sanguinary war which began in th[e] autumn of 1899 and closed in May, 190[2]. War is always in itself a calamity. No think[-] ing man can look back on the carnage, on th[e] incalculable amount of human and anim[al] suffering, caused by the late Boer war witho[ut] a shudder, yet no impartial person who has ha[d] the opportunity of comparing Dutch Sou[th] Africa before the war with what it is t[o-] day can refuse to admit that out of e[vil] great good has come. It is not my provin[ce] to-day to deal with South African politic[s], past, present, or future, but I cannot he[lp] recording the belief that only by the determi[-] nation of that obstinately fought fight—wage[d] to the bitter end by the brave burghers of th[e] Dutch republics—could the barriers have bee[n] broken down which a century of raci[al] antagonism and mutual misunderstanding ha[d] raised between two kindred though distin[ct] peoples. Not perhaps from any inherent vic[e] but from their position as an independe[nt] and a semi-independent State respectively, th[e] Transvaal and Orange Free State were stu[b-] born obstacles to the advancement of Sou[th] Africa. An *imperium in imperio*, as th[e] Romans said, had grown up in our Sou[th] African Empire. There was a state with[in] our dominion which was necessarily hostile [to] it and inevitably attracted the interested su[p-] porters of England's foes wherever they mig[ht] be. If anyone at this time of day were inclin[ed] to doubt the necessity of the late war—whi[ch] yet was not of our seeking—let him recall th[e] frenzied delight with which each Briti[sh] reverse, small or great, was greeted in a doz[en] European capitals. Could such a focus [of] anti-British sentiment as the Transvaal Re[-] public became have existed much longer wit[h-] out provoking a possibly more envenomed a[nd] destructive conflict than the one of which th[e] happy termination some two years sin[ce] became, as I am firmly convinced, the prelu[de] to the regeneration of South Africa?

Some Causes of the Present Depression.

That the South African market is at prese[nt] suffering from severe depression is beyo[nd]

ispute, but I think it can be shown that this tagnation is due to no decline in the vitality f the land, but is purely the result of an verstocking of the market, itself the result of natural if ill-timed outburst of speculative ctivity which had been penned up during the ong war. This state of affairs has been ggravated by the arrested development of the nining industry, and the slow progress of ailways and other public works on account of he scarcity of suitable labour.

When the war came to a close a "boom" n mining enterprise was confidently expected, ot altogether without reason. Speculative raders were not slow in laying in big stocks f machinery and supplies of all kinds, but wing to the sharp check to the staple industry f the Transvaal through the cause mentioned, he "boom" so long expected and hoped for, iiled to "materialise."

This overtrading in a too-confident antici- ation of a buoyant market was undoubtedly romoted by the large amount of money which as put into circulation during and after the war, the shape of pay to the troops, compensation British settlers whose homesteads had been recked, repatriation of Boer farmers, to say othing of the colossal sums spent in railway, arbour, irrigation, and other public works. ut this inflation was followed by a collapse ievitable under the circumstances, with this esult, that many South African merchants ere left with big stocks which they could not ealise; much of that stock is still being arried. Until this big volume of goods has een absorbed by consumption, trade cannot esume its normal course. In 1897 imports ere £26,779,000, while in 1902 they amounted £47,167,500. To say that in 1902 specula- ve buyers overtraded to the extent of ten or velve millions sterling is, I think, to make quite reasonable estimate. Another incentive to ie speculative spirit in South Africa at that articular time lay in the low rate of American eights which then and for some time after ood at 10s. per ton. As compared with the cord year 1902, we must expect to see a con- derable diminution in imports, perhaps for iree or four years, until some portion of the esent heavy stocks has been cleared away. hat the present depression, or as colonials y, "set back," is of a permanent nature, cannot, for a moment, be believed. This nd, with its rich soil, its boundless mineral ealth, and its almost inexhaustible gold and amond mines, has all the elements of great id abiding prosperity. It has been said that figures can be made to prove anything. But the broad outlines of statistics can no more be smoothed away than the towering crests and scarps of the Alps. In the ten years from 1894, the imports of South Africa have risen from £13,922,700 to over £52,500,000. It may be noted that in the most prosperous pre-war year the imports did not total £27,000,000. True it is that part of this increase, as already shown, is due to speculative over-buying. But making all deductions for over-trading, which after all is only the intelligent anticipation of business that may be delayed for a year or two years, but must come at last, there still remains most striking expansion in trade, which is only another name for purchasing and consuming capacity.

When, however, we come to analyse the import returns, and to distribute the respective shares in this great trade among the lands which do business with South Africa, the results are such as to give business men in this country serious matter for reflection. According to the Board of Trade statistics, the British share of the South African import trade in 1897 was £14,588,700, while our competitors in foreign lands sent goods to the value of £12,190,300. In 1903, the foreign trade with South Africa had risen to over £25,000,000, leaving to Great Britain about £27,500,000. It is to be feared that these figures are even less satisfactory than they look at the first glance. It is only too probable that some of the trade credited to Great Britain really consists of re-exports which, by rights, should be included in, and would sensibly increase the £25,000,000 claimed by foreign exporters to South Africa. In any case, a comparison of 1897 with 1903 shows that while British imports into that land have increased by some £12,911,300, foreign imports have grown by about £12,809,700. This expansion of foreign trade in a market, the possession of which has cost this country so much, is a matter of serious concern to all who desire—and what patriotic Englishman does not?—the growth of trade within the Empire, in other words, the increase of that Empire's wealth by the interchange of goods produced within its borders.

Now, we may usefully consider how British men of business may legitimately secure a larger share of the trade which is flowing into South Africa, and must of necessity continue to grow and grow, whatever temporary halts may be called by passing economic clouds, or even by the perversity of politicians. It will be

remembered that at the close of the war I was commissioned to visit South Africa, and report on the state of and openings for trade there. In my report,* issued immediately after my return, I made, amongst others, the following suggestions for improving and facilitating trade :—

That transit dues in South Africa should be abolished.

That South African railway rates should be reduced, and a uniform classification of goods provided for all the South African railways.

That freight rates should be reduced, and the "rebate" system abolished.

That a system of "through bookings" should be established.

That a uniform Customs tariff should be adopted, and a preference given to British trade if possible.

That a permanent trade commissioner should be appointed in South Africa to keep our home manufacturers posted as to the varying requirements of the market.

Since those suggestions were made transit dues have been abolished. A uniform Customs tariff has been arranged for practically the whole of South Africa; reductions have been made in South African railway rates; a common classification of goods agreed upon; and, further, the various colonies have given to British goods a preferential tariff in their markets. There is no doubt that these reforms are facilitating trade enormously, and that their introduction has only been possible since the whole of South Africa has been placed under the British flag. Much more, however, has to be done, to place South African trade on a proper footing, and in this connection I would refer to the hampering influences of the shipping "ring" controlling South African freights.

The Shipping Monopoly.

This question of shipping is to my mind one of the most vital issues that affect the position of British trade in South Africa. I may repeat once again that to the best of my belief the present hold which American manufacturers exercise in South African markets is largely the result of the low freight rates which prevailed for many years subsequent to 1890. It was greatly by virtue of these rates that American goods were able to take the place of British manufactures. The reason why the British manufacturer has been to a certa extent shut out from his own market and h seen trade which should have come his w pass into the hands of alien competitors is be found in the existence of a shipping rin technically known as the Conference, whi absolutely controls shipping rates to Sou Africa. This is no new grievance. T leading Chambers of Commerce in Sou Africa and the Natal and Transvaal legisl tures, besides numerous Chambers of Co merce in this country, have openly condemn its excessive charges and methods of ope tion. The existence of the Conference a its effect on British trade in South Afri have in recent years been ventilated the daily Press, not always it is tr with the judicious reticence that shou come of knowledge. But broadly speaking is true that for some time and even now to certain extent British merchants are subject a heavy differential rate as compared w American competitors. For some time sh sailing from New York to South Africa, whi were controlled by the Conference, were car ing American freight at 10s. per ton, as co pared with the freights of 25s. to 50s. per t which the British shipper had to bear. Ag and again was I assured by merchants South Africa that they had filled up their or books with American goods, simply becau the freightage from the United Kingdom p hibited trade with the Old Country.

I hold no brief against the Conference, a I would be the first to acknowledge the gr debt which South Africa owes to British sh ping. But there is a point at which the repa ment of a debt with interest becomes usu and I think most business men who ha calmly examined this subject will agree w me that the interest exacted by this Conferen became exorbitant some time ago. If th is one feature more than another in this syst which should condemn it in the eyes of bu- ness men, it is the so-called rebate syst which is still part and parcel of the methods the Conference. The meaning of rebate is th that 10 per cent. is added to the frei charges paid by the South African m- chant, to whom, however, this particu charge is refunded at the end of months or so, provided that he has not the meantime shipped goods by any line controlled by the Conference. The mean and object of this system is, of course, sim to bind the British merchant in the toils of Conference, and to put it out of his powe

* "Report on South African Trade." London: P. S. King and Son.

otect himself by organising a cheaper or ore efficient service,—by giving the present ipping monopolists a "big revolver" to esent at his head the moment he shows any gns of insubordination. It may be said at the forfeiture of the rebates would ter all only mean one loss, but it must remembered that the total amount of e money included under the term "re-te" is very large, and that in these days of rrow margins, merchants naturally shrink om the sacrifice which would be involved leaving these rebates in the hands of the onference. Individually, no doubt, the British ipper is helpless, but it is a question whether e mercantile community in this country terested in South Africa would not do well to ganise an alternative line capable of bringing e present Conference to reason. No doubt ch a step would involve the sinking of a rtain amount of dead capital, but in the terests of British trade in South Africa a rong decisive step like this is, at any rate, orthy of the most serious consideration. any of you are probably familiar with the tails of the competition for freights that has en going on for some time past between the ouston line (a new comer) and the Confer-nce lines, and you are doubtless aware at an agreement has just been arrived under which the Houston concern joins e "ring." For many reasons, which I ed not detail here, the Houston com-etition has always been regarded as a ischievous interference with the freight arket, and one that could produce no per-anent good to South African trade, and this inion has now been justified. An alternative medy might be found in bringing pressure to ar upon the Government of the day with a ew to giving contracts to any line which it ght be possible to organise in the interests what would be in a special sense "free ade." It must be admitted, however, that all vernments are adverse to radical measures this nature, and it is, of course, possible that putations with such an object in view would ste valuable time. The question whether pping rings, federations, or conferences ght not to be subject to some impartial ernational tribunal, modelled on the lines of Railway Commission or of the American er-State Commission is, perhaps, too large this paper, but the subject is one that will nmend itself to men interested in the world's nmerce, that peaceful exchange of com-dities which has after all been the main agent in building up modern society as it is, and was the prime factor in the grand civili-sations of antiquity.

Through Bookings.

But it is not merely in the question of freight that the British manufacturer is handicapped, serious as that disability undoubtedly is. German and American manufacturers have managed to win from us an appreciable amount of trade by the more scientific manner in which they present their goods to the South African buyer. I am referring to the subject of through bookings. In the old days, the system of quoting f.o.b. British ports, answered its purpose very well. But that time is passed. The British shipper has to meet a relentless opposition in every market to which he can send his goods. His profits are, in many cases, so narrow that he cannot afford to give his competitors a single point, nay half a point, in the game. Now the system of through bookings which has been brought to great perfection by German, and especially American shippers, is primarily designed to place the seller in the best possible position to offer his buyer the most favourable terms. Transport is, after all, as essential a factor in the price of commodities as labour, coal, or any other item in a manufacturer's bill of expenses. The virtue of through booking is this, that the buyer in Johannesburg knows exactly what a particular machine or parcel of goods will cost by the time they are placed in his warehouse, or delivered to his customer, and, at the same time, he is saved the use of forwarding, and other agents. It is herein that the practical American has stolen a march on the conservative British merchant. Take the operation of through booking. As a con-crete instance, a miller at Minneapolis, in the State of Minnesota, knows to a cent. what it will cost to ship a given parcel of flour to Hong-kong some seven thousand miles away. This is because a certain enter-prising railway manager in the United States has had the thought to provide what are there called "through rates" or, as we should say, "through bookings," from Minneapolis, by rail to the Pacific and thence by sea to Hong-kong. In the same way American, and let me add Canadian enterprise, has made it possible for a merchant in Shanghai, Tokio, or Yokohama, to book through rice, tea, or any other merchandise to Chicago or Boston, to Winnipeg or Montreal.

British merchants who feel inclined to treat this as a question of detail had better place

themselves in the position of a buyer at some up-country town in South Africa. Instead of having to calculate and as things are he often cannot help miscalculating the price of transit from Southampton to his store, he knows exactly the prime cost of the goods in which he is dealing, and has the great advantage of being able to quote his customers a nett inclusive price. This system of "through bookings" seems to need no recommendation other than its inherent advantage in saving business men time, labour and expense. But I cannot help quoting some words of Mr. T. R. Price, general manager of the Central South African Railways, on this important subject. He remarks that "the need of establishing a system of 'through bookings' of goods and produce between centres of trade in Great Britain and the chief inland towns in South Africa, to be followed later by similar trade facilities with other British colonies, is becoming more and more urgent. The impetus that would be given to trade and its development, the means by which the various commercial and other interests of Great Britain and this portion of the Empire would be brought into direct and closer touch, and the extent to which the cost of transport and the cost of articles of consumption would be reduced inland, particularly the consuming centres of South Africa, and the better markets and prices our products would probably secure, would be very great."

I know it to be an actual fact, that American manufacturers are pressing the South African railways to arrange with them a system of through bookings from the United States but they have not, so far, consented, realising that it would be a severe blow to British trade. But the request is such a reasonable one that there is every probability of an arrangement being made in the near future. Will British traders not bestir themselves in the matter? Some opposition will doubtless be met with from the shipping ring, and British railway companies will possibly object at first to make the reductions necessary on a rate of this kind, but these are matters which might be adjusted if the South African commercial community would combine in the matter. So far as the Cape and Central South African railways are concerned, I am in a position to say that they would make some sacrifice to bring about through bookings with Great Britain and her colonies, and I have no doubt that the Natal railways would do likewise.

I am quite aware that through bookings are not popular with all classes of the South African commercial community. They coul not be expected to be because in all importan business changes some interests are liable t suffer, though usually the actual loss is com paratively insignificant. In the present case the system of through rates is distasteful t what may be termed the distributors, who hav a natural reluctance to bring the manufacture and the actual consumer into touch. But a business men middlemen cannot be obliviou of the fact that trade must in the long run tak the surest, quickest, and least expensive route

A Permanent Trade Commissioner Wanted.

If I were asked what after a reasonable an efficient shipping service supplemented by scientific system of through booking is th greatest need of South Africa, I should answe information and more information. Th British merchant needs to be thoroughly poste in the wants of so wide and yet so sparsel populated a country as South Africa. He ca only use his own eyes at considerable expens by touring through the country, and in thi connection it is well to remember that th man who has been to South Africa to gathe commercial information and has not traversed i from north to south, from east to west, has thrown his money and what is worse his time away I know of no country in which wide, and yet at the same time, exact knowledge is more urgently required by the manufacturer o merchant who would establish a business there. The Americans, who, in many matters commercial, are ahead of us, recognised twenty years ago and more the value of systematic collection of commercial intelligence. Austria-Hungary and Japan, to say nothing of Germany and the United States have official agents, whose one business it is to collect useful information for the benefit of manufacturers and traders at home. Such agents are either permanently located in one country, or are despatched on special missions. But that is a mere detail; the important fact is this, that their respective Governments consider it vital to trade and industry, to provide sure information as to the capabilities and possibilities of foreign markets. Besides these special agents the Consular Service of some foreign countries, and notably of the United States and Austria-Hungary, are pressed into this useful work. I am sure the excerpts from Austrian Consular Reports which I have had occasion to read now and again in Continental trade papers,

re models of what a commercial report should e. Usually speaking, the capacity of a given ıarket to receive a given line of goods is etailed in a paragraph of 15 to 20 lines. In ıost cases prices in the foreign market, with ough estimates of freight, are quoted, and early always the writer is careful to detail hat foreign competition may be expected, oth in price and quality.

The man appointed as trade commissioner hould have an office, say at Johannesburg, nd be assisted by sub-agents. He should ave available, for the use of Colonial buyers, a brary of catalogues and price lists of British ıanufacturers, so sectionised and indexed as o make it capable of easy reference. He ould invite suggestions from merchants, raders, and large users of machinery and oods in his territory, as to how British pro-uctions could best be made to suit local onditions. He would himself regularly travel hrough his territory and keep in the closest ouch with trade developments and report, as ccasion demanded, to the London office, not n a general way as consular officers and other orrespondents do at the present time, but vith the fullest details as to prices, sizes, veights, and quality, with drawings, ideas in egard to design and such practical details nd information as the British manufacturer nd trader can use in a practical way. Where penings for trade exist and where contracts re going, cable messages might be sent in rder that the British manufacturer and trader night be informed at the earliest possible ime.

But these are details capable of ready ad-ustment once the principle is admitted. The nere cost of the agent and his staff, including he supplementary expense of cables, should veigh as nothing against the priceless advan-age of placing at the service of every British nanufacturer and merchant information indis-ensable to successful business in South Africa. If additional argument were needed n favour of this suggestion, it would be found n the far-seeing spirit with which our Colonies ears ago anticipated, to a certain extent, this dea by appointing Agents-General and other fficials, whose main purpose was to provide he Colonies with accurate information respect-ng the needs and possibilities of the home narket. Canada and New Zealand have also appointed permanent trade commissioners in South Africa. Surely what is good for each ndividual colony must also be to the exceed-ng advantage of the Motherland.

The Labour Problem.

We have now entered on what is undoubtedly one of the most thorny questions connected with the commercial future of South Africa. The existing depression is partly, though, as we have seen, not entirely, due to the check which the mining industry has received both in Rhodesia, and still more in the Transvaal on account of the increasing scarcity and dearness of native labour. Perhaps to inquire fully into the causes of this unsatisfactory state of affairs would consume more time than it is worth. It is enough that the existing supply of black labour is quite insufficient. In my opinion there is no doubt that the war is very largely responsible for the reluctance of Kaffirs to work at wages which mine managers and farmers deem fair and reasonable. During the war the better class of Kaffir labourers found abundant employment on railways under-taken for military purposes and in transport and other necessary work for the army. The military authorities, whose one concern was the welfare of the troops and the efficient prosecution of the campaign, found it better business—I use the words advisedly—to over-pay the black man than to drive him with the point of the bayonet. The consequence was that while the army service got the best out of the Kaffir, they spoilt him to a great extent for everyday civil life. His ideas of what is fair pay for a fair day's work seem to have risen to extravagant heights, and constituted as the black man is, it may be years before the mischief thus unwittingly done can be repaired. No blame can be imputed to the energetic officers who were the unwilling means of spoiling the supply of black labour. They acted for the best in a great emergency, and, from a military point of view, their action was entirely justified. Nevertheless, the fact remains that the Kaffir finds it exceedingly difficult to settle down to industrial life, the while that there is urgent need for his services, or for those of some equally efficient unskilled labourer in gold and diamond mines, on rail-ways, and other public works, to say nothing of the tillage of the land where a certain amount of black labour is absolutely indispensable. The immediate crisis has arisen in con-nection with the gold mining industry, but scarcity of labour is at the root of half the de-pression with which South Africa is now afflicted. Provide sufficient unskilled labour for the gold mines, and you will set free a certain number of black boys who will inevit-ably gravitate to those farms in the Transvaal

where their services are most needed. At present the farmer has to pay what he deems an exorbitant wage to his black labourers, but the competition which the influx of newcomers on the veldt will necessarily bring into existence, will tend to reduce wages to a more workable level.

As I have said, the delay in the settlement of this labour question is hindering the development of South Africa. Not only are the gold, coal, and other mining and agricultural industries seriously affected, but the progress of practically all industrial enterprises and of Government and other public works has been arrested. For instance, a large programme of railway development in the two new colonies involving an expenditure of five millions sterling has been suspended owing to the impossibility of obtaining cheap labour to carry it out. For three years this work would require fifty or sixty thousand natives in constant employment, and as a native will seldom engage himself for a longer term than three months at one time, the scheme would involve draining the country of some 150,000 "boys." British South Africa does not hold a sufficient number of natives to fill the requirements of the various industries, and recognising this, the railway authorities of the new colonies prefer to shelve their schemes for the time being, and to wait until imported coloured labour releases some of the natives now employed in mining work.

Unskilled white labour has been, as you all know, fairly tried for mining and railway work in the new colonies as well as in Cape Colony and Natal, and has, in almost every case, been pronounced a failure. I believe that in South Africa white unskilled labour cannot possibly take the place of black. A native will do more work at a very much less cost than a white man, while the food and conditions of life generally are altogether more suitable to his employment. Besides, it must be borne in mind, that if climatic and other conditions were congenial to white labour, the majority of the gold and coal mines could not possibly be worked at a profit if unskilled labour were paid for at white man's rate. This is generally admitted by all who have studied the economic conditions of South Africa. I will, therefore, not go into figures here to prove this to you, for although it would be a very simple matter, it would take up too much time.

One hardly cares to touch the question of Chinese immigration after all the heat which that subject has occasioned in political circles, but the importance of an immediate supply of cheap labour being obtained compels i to refer to it. The gold mines as they n exist are, with few exceptions, deep le mines, in which the cost of working is v heavy, relatively to the possible output, and would be simply impossible to work the b of these mines at a profit if white labour h to be employed. Few people are aware how narrow a margin the gold miner has work. The popular conception of gold-mini in the Transvaal is somewhat that of sinking shaft into the ground and pulling out nugg of gold with a grab or a shovel. As a matt of fact, nothing could be farther from t truth. Nowadays a proposition, as a minin venture is technically termed, which offers fair prospect of returning 18 to 20 dwts. pure gold to the ton, is jumped at by minin magnates. But what does this mean in t heavy labour involved in drilling out the roc of quartz in which the veins of gold a usually found, crushing and washing ther So heavy are the present day expenses deep level mining that the merest fracti may make all the difference between reaso able profit and positive loss. If the go mining industry is to be maintained, and o that industry the prosperity of the Transva directly and indirectly depends, some suc arrangement as the importation of indenture Chinese labour was inevitable. The mistak which fluent but ill-taught political agitato have made lies in assuming that the system isolation in which the Chinese labourer is t be kept is intended to veil a system of slaver The Chinese coolie who indentures himself f work in the gold mines does so voluntaril and does nothing more than bind himself to period of specific service, such as the sail enters into who signs articles on a ship. Th one is an artificial life, and so is the othe But the system of isolation which is to b practised is solely conceived in the bes interests of Chinamen and colonists alike. Th Chinamen will be protected from any ebullition of race prejudice while the insuperable repug nance of the colonists to the admission o yellow men as settlers is effectually met. confess that I could have wished that th authorities in the Transvaal had found i possible to supplement black labour with som of the hardy men with which the India peninsular teems. But there were consider able difficulties in that direction. It i probable that the Viceroy's Council woul not have sanctioned the compound syste which, under existing conditions in Sout

ıfrica, is absolutely essential to the success of ny scheme of imported labour. Of two evils /e have been told to choose the least; and I eel sure that Lord Milner and his advisers, in cting as they have acted, have taken the only ourse which was compatible with the orderly nd progressive development of the all-im- ortant industries of the Transvaal.

THE FUTURE.

The business community in this country may nake up its mind that the serious crisis which Lord Milner has felt it his duty to place before he Imperial Cabinet is no bogey, no phantom of the imagination. A letter just received by ne from a friend in Johannesburg, a sober nan of business, who is not given to painting n black, describes the business situation as one of absolute stagnation, mainly owing to he scarcity of suitable labour. Fortunately he powers that be, both in South Africa and n this country, have had the moral courage to neet the great difficulty in the only way in vhich it could be met. There are at the present time some 2,500 stamps idle on the Rand, which really means that work is awaiting over 100,000 coloured labourers and over 10,000 vhite men. The resumption of the work in the gold mines under the conditions indicated, will nean that a fertilising stream will be set run- ning over the Transvaal, and to some extent over the whole of South Africa. I do not wish o be too optimistic. To believe that with the loing away of the present labour difficulties, a econd "boom" such as greeted the con- clusion of peace in June, 1902, will be naugurated and will last for ever, would be to imagine a vain thing. The causes of the existing stagnation have been sufficiently indicated in this paper, and one factor in the present dulness, namely he over stocking of South African ware- houses can only be removed by time. But under the beneficent dominion of Great Britain the future of South Africa is assured. Think how rich the soil must be, on which the Boers with their primitive methods of agricul- ure, managed not only to live but thrive exceedingly. What then should be the future of a country which in addition is favoured with almost every kind of mineral wealth?

The British authorities, both in South Africa nd at home, have shown the utmost willing- ness to promote the welfare of the land by very means in their power. The abolition of ransit dues, unification and reduction of rail- vay rates, the uniform Customs tariff for British South Africa, the preference granted on goods from the mother country; these are no small reforms for the State to effect in the brief space of two years. It now lies with the business men of this country to second effectually the work of reform carried out by the various colonial Governments by insisting on the accomplishment of those commercial reforms on which it has been my privilege to discourse to-day. Let the present shipping monopoly become a thing of the past. Place the British manufacturer and merchant in a position to cope by means of "through rates" with any foreign competi- tors; and, above all, let the home producer seriously and truly, as do his rivals abroad, inform himself as to the actual condi- tions and magnificent possibilities of this great market. If the business men of this land will be but true to themselves, they will not only reap great profit, but will be the means of actively promoting what is the heart's desire of every true Briton, namely, the Regeneration of South Africa.

DISCUSSION.

The CHAIRMAN said he was sure that he would be only anticipating the wishes of the meeting if he at once gave expression to their thanks to Mr. Morgan for the excellent, moderate, and convincing paper which he had read. It must be a great pleasure to those persons who took an interest in South African affairs, to pass from the vague rhetoric and platform vapourings of the ill-informed, to statements based upon knowledge and personal observation of South Africa, and couched in temperate language and supported by reasons which would hold their own against the most searching criticism. He had himself paid three visits to South Africa during the last ten years, and to him the word South Africa had a ring which was not only very interesting but was full of hope. His next ten years would be less happy than the last if they were not able to record a similar experience. More than twenty years ago Sir Bartle Frere, whose name ought never to be mentioned without honour in any assembly of Englishmen, wrote from South Africa to say that, in his opinion, given fair and just and equal government, South Africa from the Zambesi to the Cape would in course of time supply homes for as many educated Englishmen as the United States of America did to-day. The whole problem was how they were to obtain those conditions. The reader of the paper had pointed to those long fits of indifference to South African affairs to which the stay-at-home Briton was prone as one of the dangers which might possibly affect the future of South Africa. Without being hypercritical, he (the Chairman)

might say that they could very well afford to have one of those long fits of indifference to-day, and allow their fellow subjects of the King, in South Africa, to manage their own affairs without quite so much interference. To his mind the long fits of indifference were less dangerous than the ignorant interference of men who view the landscape from 7,000 miles away through the distorted glasses of party politics. According to the view expressed by Mr. Morgan in his paper, the future of South Africa depended on three things, and he (the Chairman) would add a fourth. Mr. Morgan had said it depended, first of all, on the mutual respect of the Boer and the Briton, and he had pointed out in eloquent terms that one good effect of the unhappy war which had recently taken place was that it had broken down a good deal of that racial antagonism and prejudice which had previously existed, and had given to Boer and to Briton a genuine feeling of mutual respect and esteem which, if not interfered with by mistaken politics, could not fail to fuse the Boer and the Briton before long into one solid and undivided people. The aim of this country from the first had been simply to give the Englishman the same rights as were enjoyed by the Boers, and to put the Briton on an equality of political power with the Boer in all things. He thought he might say, without offending the well-established rule of the Society excluding party politics, that, until they had showed their self-respect by securing for the English communities in the Cape a representation in fair proportion to their numerical strength, they would not have secured for them those equal political rights to which he had alluded, and consequently could not hope to keep the respect of the Boers. The second essential factor in the regeneration of South Africa was a sufficient supply of unskilled labour. The paper had pointed out, as everyone who had been in South Africa knew, that the white man would not undertake work which in his opinion degraded him to the level of the Kaffir, and, therefore, that unskilled labour which lay at the foundation of all industrial enterprise must be done by the coloured races. And, further, owing to the fact that the labour requirements of industrial enterprise were greater than the natives of Africa could supply, it was absolutely essential to supplement the deficiency by an importation of labour from the outside. Mr. Morgan had pointed out that there were 2,500 stamps idle. But, not only was that the case, but arrangements had been made to enable 8,000 additional stamps to be dropped as soon as sufficient labour could be obtained. Both for economical and for political reasons the temporary employment of indentured Asiatic labour was absolutely essential. With an adequate supply of coloured unskilled labour, thousands of British artizans would have highly-paid employment in South Africa, for whom at present no employment could be found, and there would be an increased demand for British manufactures, and consequently increased employment for British labour and capital at home. Moreover, the South African Colonies would be able to meet with ease their heavy obligations. Before the war the debt of the Transvaal was 14 millions; it was now 70 millions. The indebtedness of Natal and Cape Colony had also greatly increased. Unless a sufficient quantity of coloured unskilled labour was obtained, South Africa could go into liquidation, and they might make up their minds to hand over the whole of South Africa back into the hands of the Boers. That was the political reason which lay at the bottom of the necessity of the temporary employment of the indentured Asiatic. Another essential factor in the regeneration of South Africa was a reduction in the cost of living, and they could not hope to reduce that cost unless there were cheap railway rates, low taxation, and a prosperous home agriculture; and all those three things depended upon a prosperous mining industry, which, again, depended upon having a large amount of unskilled labour. The cheapening of the cost of labour also depended, as the paper had stated, upon the scientific organisation of our transport and distribution services. Mr. Morgan had pointed out that, of the six recommendations which he made when he was last in South Africa, three had been already adopted. He (the Chairman) congratulated Mr. Morgan upon the fact that half the proposals which appeared to his scientific mind to be urgently required were now *faits accomplis*. He hoped that the other three recommendations which Mr. Morgan had made and had again urged with so much force, would also soon become accomplished facts. He attached great importance to the way in which the English Government placed its freight contracts. It touched the consumer at every point in South Africa, and the fear that the acceptance of a casual outside tender must place the Government at the mercy of the conference ring, was, he believed, absolutely unfounded. He was at one with Mr. Morgan in the opinion that it was desirable that his Majesty's Government, in the big freight contracts which they had control over, should place them in such a way as to get the lowest freight for the carriage of their tonnage. There was a precedent in the case of the Government of India. The India Office had never allowed themselves to be dictated to, and had never attempted to deal with their freight contracts on the rebate system; and, if the Indian Government could afford to act thus, the English Government and South African could also afford to do so. It might be a surprise to many persons to hear that, in consequence of the Government having refused to give freight contracts to an independent line of steamers outside the conference ring, the freight contracts for tonnage from American ports had been 10s. a ton, as against 25s. a ton from British ports. No doubt if the Government had given the freights contracts to Messrs. Houston, they would have been able to secure the advantage of that cheap freight for British manufacturers, and so secure for British manufacturers a great part of that trade which had found its way to America. As to the

fourth factor, he would allude to it in the briefest possible way. It was that they must have a sound native policy. To his mind, it was not the yellow peril, but it was the black peril that ought to occupy the minds of British statesmen in connection with South Africa. The English Government was drifting in its native policy, and he thought that the time had come when they should secure the very best brains that could be found in England, Africa, and America, which had had her own race problems to deal with, and think out in conference the problem of what were the duties of the white races to the black races under white control. At present, as he had said, our native policy was drifting. The Kaffir was getting very high wages. If a Kaffir in the Transvaal liked to give two years' continuous work he could obtain employment at £3 a month, plus food and lodging, and thus, at the end of two years, he would have earned £72. Supposing that £22 of that sum was spent by him in luxuries and blankets and in presents for his own people, he could still retire with £50. That sum would enable him to set himself up for life. He could, for instance, buy four or five wives, and all he would have to do would be to sit as a little potentate over his wife community while they grew grain for him which would enable him to pay the slight tax levied on him. The British Government had got to consider whether it was going on safe lines in encouraging a policy under which the two pillars of native society were polygamy and slavery. The whites of South Africa were surrounded by a numerous black population, which now that they were prevented by the Pax Britannica from eating each other up, would grow with remarkable fecundity, and he maintained that it was dangerous to allow the black men to grow up, in the belief that all that they were expected to do was to live the lives of Sultans holding dominion over slave-wives.

Mr. E. B. IWAN-MÜLLER said that he visited South Africa four years before the war, and while the war was going on. He believed that this country, having established a Government in Africa, which would prevent the black people from eating one another up, and, having minimised the great danger of constantly-recurring famine, should have, in the course of twenty or thirty years, a new native population to deal with, and he should have thought that that very fact would have disarmed the opposition to the employment of Asiatic labour. He did not know who liked the importation of Chinese labour, *per se*, or who wished for it *per se*, but it was only intended to be an absolutely temporary expedient until there was a sufficient native population. But the native population, unless the English Government adopted a systematic and consistent policy towards them, would become a far greater danger, not only to Britons, but to Boers, than any possible evil which could result from the importation of yellow labour. He was not able to say what the policy of the English Government should be in that respect. It would be a complicated policy, and it would require the experience of persons who had had to deal with native races before a final opinion could be expressed about it. It was difficult for him to say, without incurring the danger of being misrepresented, that liberty was not, under all conditions, an absolutely unqualified blessing. It might at once be said that he was advocating a return to slavery. They had heard a great many statements of that sort lately. But, as a matter of fact, to give liberty to a people who had not been trained to enjoy it without abusing it, was like giving bucketsfull of water to men who were dying of thirst on a raft. Anybody who was familiar with Kimberley, for instance, and knew what that place was like in the old days before the compound system, would know what the streets of that place used to be like on Saturday nights. At those times manslaughters and other outrages were committed every Saturday, but the compound system which had been introduced there had saved the natives from such excesses. The system was not a system of slavery. The doors opened out and did not open in. If a man broke his contract and did not come back to his work he could go. He had no hesitation in saying that a man who worked for two years in a compound would return to his own people a more civilised man than he would have become in twenty years under any other kind of labour. He would go out a better man, morally, physically, and in every other possible way than he was when he entered.

Mr. HENRY BIRCHENOUGH said that he wished to say a few words entirely as a business man. The one thing which they ought to pray that South Africa might be delivered from, was the politician. If the English people could forget South Africa for three or four years, and leave the very competent and able men who were there to work out its destiny, it would be the very best thing that could happen to that temporarily unfortunate colony. What South Africa wanted, was business administration, business gifts, and business talents, to drag it out of the rut into which it had fallen. He had never found that the ordinary citizen really understood the extraordinary commercial importance of South Africa to this country. It came as a matter of surprise to most people, to find that, during the last two years, South Africa had been the second best customer which England had, and had taken more of the manufactures and products of the United Kingdom than any other country except India. Although it was true that during the last two years there had been a certain amount of over-trading in South Africa, he was sanguine enough to believe that that was only a temporary phenomenon. If, instead of talking in clubs and imagining all kinds of things, they would go to South Africa and see for themselves, they would

form just conclusions. It was extremely difficult to avoid using language which sounded exaggerated with regard to the mineral resources of our new colonies. At present the gold industry had hardly been touched, and, besides this, there were coal and iron in enormous quantities, and diamonds both in the Orange River Colony and in the Transvaal. The mineral wealth of those colonies was almost boundless, and the expenditure required upon public improvements was absolutely enormous. The Boer Government never did anything whatever to make life in their towns even bearable. In Johannesburg, a large prosperous city, there was not even to-day one single presentable drain. Every single drop of slop water was carried away in buckets every night at the cost of £200,000 a year. The same state of things in a less degree existed in many of the large towns in South Africa. And then agriculture was comparatively undeveloped, indeed there was no branch of human enterprise which was not calling loudly for the investment of capital for its development. What stood in the way? It was one single difficulty, and that was the want of unskilled labour. Just before Easter he was stopped by a procession of British workmen trudging along to Hyde Park in order to demonstrate their desire that South Africa should be still further starved of labour, and, if what those British workmen demanded took place, the resnlt would be that many of themselves engaged in engineering and similar trades, would have to be turned off from their work. When he saw them he did not know whether he felt more saddened by the generosity of their intentions or by the folly of those persons who had driven them into such a demonstration. It was needful to bring before the minds of the English people the fact that South Africa represented for Great Britain a most remarkable market for British industrial products. Whereas the other markets which took British goods were gradually drying up under various influences, we had in South Africa an almost virgin market for the expansion of British trade. He was more sanguine than the reader of the paper with regard to the opening for British products in South Africa. He admitted that there had been an enormous extension of foreign trade in South Africa, but when the returns were examined it would be found that that trade consisted to a very large extent of articles with which England could never hope to compete, such as food stuffs, building materials, and other things which Great Britain herself imported from foreign countries. The rapid expansion of the trade in imported food stuffs was due to the fact that since the war South Africa had been almost entirely unable to feed itself. Every article which the builder required, except brick and stone, had to be brought into South Africa by sea and by rail, and even the mealies which constituted the main food of the Kaffirs had had to be brought from Argentina instead of being grown in the colony. Nothing gave him so much pleasure while he was making investigations in South Africa as to find to what a large extent th different parts of the British Empire were beginnin to supply each other's needs. A large proportio of the bread stuffs eaten in South Africa came fro Australia; butter was obtained from Australia; an frozen meat was obtained from New Zealand an Australia; and we might look forward to the differen parts of the Empire increasingly supplying the nee of South Africa. One of Mr. Morgan's recommenda tions was that a permanent trade commissioner shoul be appointed in South Africa to assist and advis British traders. The Imperial Government ha already appointed official correspondents in Sout Africa, and these gentlemen were at the service any manufacturer in this country who chose to com municate with them either directly or through th Board of Trade. These correspondents were alread frequently sending home what in colloquial languag were called commercial "tips" which, he felt sur would be of very great value to those persons wh made use of them. He thought that there was great deal of confusion in the public mind with regar to the question of Chinese labour. There seemed t be an idea that special measures were required fo the assistance of the gold mining industry, and o that only. The fact was that the labour proble which South Africa had to solve was one which con cerned all the industries. The only reason why th gold industry came to the front in the discussion o this subject was that the gold industry was the pivo upon which the prosperity of South Africa turne That was the reason why labour must be supplied t the gold mines first. The moment the gold mine were supplied with labour, other industries woul begin to develop in every direction. The gol question was the one which lay at the root of a other developments. There was no greater mistake tha to suppose that the exceptional measures which wer being taken were for the benefit of the gold industr alone. The interests of the Transvaal and the Orang River Colony were identical with the interests of th maritime colonies of Natal and the Cape, and th trade of the maritime colonies, which were th sea-gates of South Africa, was dependent upon th inland colonies. The English people might res assured that, if there was slackness or depression o trade in the inland colonies, there would be de pression of trade at the ports. They could not hav a prosperous Natal or a prosperous Cape Colony unles they had a prosperous Orange River Colony, and, stil more, a prosperous Transvaal.

Mr. CORNELIUS ROZENRAAD said that hi impression was that, if they wanted to bring Sout Africa to prosperity, it was necessary to send out th best men there—men who thoroughly understoo commercial policy, finance, currency, and banking and who could be intermediaries between the Boer and the British population. He was not implying that the men who had already been sent were not th

best. He had studied the financial situation of the country, and his impression was that much more could be done at present by business men. Mr. Chamberlain said at Birmingham that trade and commerce were the greatest interest of the nation. Why not apply that in South Africa? He was convinced that, if they applied that policy, prosperity would follow.

A vote of thanks to Mr. Morgan, proposed by EARL GREY, was carried unanimously.

Mr. H. A. WOOLF, of Johannesburg, writes:—As a resident for over fourteen years in the Transvaal, I listened with much interest to Mr. Morgan's paper. He has evidently made a careful survey of the present situation; his deductions being for the most part in harmony with the views of those who possess long local experience, and his suggestions eminently practical. It was impossible in a paper of this character to discuss every point, and it occurred to me that, although efforts are being made, not sufficient encouragement has as yet been afforded to induce experienced agriculturists with their families, who are willing to work themselves, and not be entirely dependent on native labour, to make South Africa their home. Of course, at first there would be many trials to face and difficulties to surmount. But I have every confidence that, were the right class selected, they would not only prove successful, but would help to assimilate the two white races more naturally and effectively than by any other means. Then again in a country where minerals of all descriptions abound, where cattle-rearing on an extensive scale is undertaken, and where oil-producing plants of various species can be cultivated, is there not a vast field for manufacturing and industrial enterprise? Obviously in a country which continues to charge a 10 per cent. *ad valorem* duty on such goods as chemicals and raw materials required for manufacturing purposes, and the railway system of which exacts as high and in some cases a higher tariff than on the manufactured articles, an effective barrier against manufacturing industries must exist. I know of no other country in the world where such a system would be tolerated. Were facilities afforded in the direction indicated I do not hesitate to predict that factories would spring into existence and a large demand for skilled labour be created. The country would not then be entirely dependent on the mining industry, and the large increase of population that would inevitably follow would not only counteract all fear of Dutch predominance when responsible Government has been granted (which in the best interests of the colonies should not be long delayed), but would help in no small degree to contribute to the taxation which threatens to burden the present population beyond its capacity.

EIGHTEENTH ORDINARY MEETING.

Wednesday, April 27, 1904; COLONEL S. A. SADLER, M.P., in the chair.

The following candidates were proposed for election as members of the Society:—

Bell, Mrs. Jeannette, Rotherby-hall, Leicester.
Bright, Miss Agnes, Winton-house, Leamington.
Chester, Arthur, A.I.E.E., 26, Balmoral-chambers, Commissioner-street (P.O. Box 3817), Johannesburg, Transvaal, South Africa.
Hindley, Oliver Walter, B.A., Assoc.M.Inst.C.E., care of Messrs. King, King and Co., Bombay, India.
MacCarthy, John Leader, B.A., Assoc.M.Inst.C.E., Compass-hill, Kinsale, co. Cork.
Vare, William Edmund, Mem.San.Inst., Bodorgan, Mayfield-road, Weybridge, Surrey.

The following candidates were balloted for and duly elected members of the Society:—

Ambler, Ratcliff V., A.M.I.Mech.E., Messrs. Gibbs and Co., Iquique, Chili, South America.
Bobbili, The Maharajah of, K.C.I.E., Sanasthanam Huzur Office, Bobbili, India.
Cattley, James Edward, 24, Uxbridge-road, Ealing, W.
Chippendale, Arthur, International Banking Corporation, Coliseo Nuevo 4, Mexico City, Mexico.
Currey, Percivall, F.R.I.B.A., 37, Norfolk-street, Strand, W.C.
Dinanath, Rao Bahadur Trikamlal, Dewan of Dharampur State, Dharampur, Surat, Bombay, India.
Dingwall, William Burliston Abigail, Sta. Maria de la Paz, Apartado 116, Matehuala, San Luis Potosi, Mexico.
Dudley, Dr. Charles B., Pennsylvania Railroad Company, Altoona, Pennsylvania, U.S.A.
Holdcroft, J. P., Park Terrace, Tunstall, Staffs.
Jennings, Lieut.-Colonel Robert Henry, R.E., C.S.I., The Residency, Jodhpore, Rajputana, India.
Khan, Colonel Nawab Muhammed Aslam, Khan Bahadur, C.I.E., Peshawar, North West Frontier Province, India.
Kirkby, Reginald Guy, A.R.I.B.A., P.O. Box 7, Pietermaritzburg, Natal, South Africa.
Lawrence, Christian William, J.P., Sandywell-park, Andoversford R.S.O., Gloucestershire.
Morgan, William Houlston, Rhayader, Mid-Wales.
Pittar, Albert Vyvyan, A.M.I.Mech.E., 51, Primrose buildings, Fraser-street (P.O. Box 5627), Johannesburg, Transvaal, South Africa.
Pratt, John, 502, East Fifth-street, Chattanooga, Tennessee, U.S.A.

Sjögren, Professor Hjalmar, Academy of Science, Stockholm, Sweden.

Taberner, Captain William, R.E., Orrell Hall, Wigan.

Vijaydevji, Kumar Shri, Dharampur, Surat, Bombay, India.

Wigan, Mrs., 2, Cavendish-place, W.

Wilson, C. Herbert, J.P., F.G.S., The Associated Financial Corporation, Limited, Pine Creek, Port Darwin, North Australia.

The paper read was—

THE NEED OF DUTY-FREE SPIRIT FOR INDUSTRIAL PURPOSES.

By Thomas Tyrer, F.I.C., F.C.S.

Most of you are probably aware of the facts that for many years the Chemical Committee of the London Chamber of Commerce has been dealing with this question in a practical way. The policy pursued by the Chamber, and latterly by the Society of Chemical Industry, has been by education—the quiet education of the authorities to the possibilities of the law as administered by them. I venture to think that the progress exhibited within the last year or two might have been made under the old Consolidation Act, 1880. That Act defined as precisely as it well could what control should be exercised over the industrial processes of fermentation and distillation involved in the production of alcohol. It prescribed limitations as to time, space apparatus, quantity and quality. Almost despotic control was authorised and exercised at every step at vast expense, and so far as the regulation of apparatus was concerned, at increased cost of production. In the papers read before the London Section of the Society of Chemical Industry in 1903 and 1904, it was admitted that the dangers incidental to the unlimited production and use of alcohol in any form, long ago marked out liquids containing it for fiscal, social or domestic treatment. Moralists regarded it as a justifiable subject for watchful supervision and consequent taxation; public financiers—probably not a whit less anxious than the moralists, eagerly sought its acid as a revenue producing agent. Some eighteen to twenty millions of revenue under British fiscal conditions is no light matter, and naturally, minute and extraordinary conditions for regulation and control were enacted and enforced. We have to deal with present day conditions, and therefore need scarcely dwell on the early history of this question. Yet unless some reference is made, those who have not perused the papers referred to, will scarcely apprehend the position, and one may quote bodily the extract relating to the evolution of the "differential duty;" the point in Clause 8 of the Finance Act, 1892, on which the concessions to industrialists turn. First, however, let us have the terms of the Clause itself defined in the margin thus:—"Power to authorise use of spirits *without payment of duty* in art or manufacture."

Clause 8. - (1) Where in the case of any art or manufacture carried on by any person in which the use of spirits is required, it shall be proved to the satisfaction of the Commissioners of Inland Revenue that the use of methylated spirits is unsuitable and detrimental, they may, if they think fit, authorise that person to receive spirits without payment of duty for use in the art or manufacture upon giving security to their satisfaction that he will use the spirits in the art or manufacture and for no other purpose, and the spirits so used shall be exempt from duty. *Provided that foreign spirits may not be so received or used until the difference between the duty of customs chargeable thereon and the duty of excise chargeable on British spirits has been charged.*

(2) The authority shall only be granted subject to a compliance with such regulations as the Commissioners may require the applicant to observe for the security of the revenue, and upon condition that he will, to the satisfaction of the Commissioners if so required by them, render the spirits unpotable before and during use, and will from time to time pay any expenses that may be incurred in placing an officer in charge of his premises.

(3) If any person so authorised shall not comply with any regulation which he is required to observe, he shall, in addition to any other fine or liability, incur a fine of fifty pounds.

The differential duty is not alone one practically of "protection," but of compensation for very real and important hindrances imposed upon the British distiller which are not so imposed upon the Continental, particularly German competitors. I venture to reproduce the quotation from the paper of 1904 on this point, quite as much for information as an illustration of the methods of the Revenue departments.

The quotation is taken from Scarisbrick's "Spirit Manual":—

"The distiller was required to produce 1 per cent. at proof for each 5° attenuated in the case of wash from grain or potatoes, and for each 4° in the case of sugar wash.

"The use of mangold wurtzel in preparing wort

was sanctioned in 1833,* the old regulation still being continued that no two kinds of material (except malt and unmalted corn) were to be used in combination. This restriction was justified by the fact that worm-ends and spirit store were open and under the distiller's absolute control. The subject was pressed on the attention of the country in 1846. It was found that the restriction to use only one class of material at one time, together with the exaction of a Customs duty on sugar, virtually prohibited distillation from any material except grain. This attracted attention, owing to the complaints of West Indian planters, who happened to be the largest sugar producers. They strongly urged the impolicy and injustice of excluding their produce from the breweries and distilleries of this country, and it became a question of moment to determine whether the use of sugar and molasses, mixed or unmixed with other materials, could be allowed without impairing the security of the revenue. Experiments for this purpose were commenced by Messrs. Dobson and Phillips, in the excise laboratory, where the comparative values of barley, malt, sugar, and molasses to the distiller and brewer were accurately ascertained. An Act† was therefore passed in 1847 authorising the use of sugar in distilleries, with drawback of the Customs duty, excepting so much as would be sufficient to countervail the duty on the small quantity of malt necessarily used by distillers. In the following year molasses and treacle were allowed.

"As the trade wished an allowance for deficiencies in spirit store, it was found necessary, in 1853, to insist upon the worm-end being enclosed, and the stock placed under the officer's control.‡ Decreases from natural waste, filling, &c., not exceeding 1 per cent., were then exempt from duty. The contents of casks were to be determined by gauge or weight, and the distillation process of determining original gravity of beer was extended to diutillers' wash. In 1855 all materials were allowed to be used duty free, thus ending the frauds in connection with the drawback on materials. The duties in England and Scotland were equalised in 1856, and in the United Kingdom in 1858, the rate being 8s. per proof gallon.

"Owing to the higher character of the trade, and the revenue safeguards furnished by closing the worm-end, and the system of determining original gravities, the time had come for concessions. It was considered safe to abolish the following prohibitions: (*a*) against grinding malt with stones; (*b*) use and sale of yeast; (*c*) continous running of common stills. It was also found that the following could be granted without impairing revenue security: (*a*) giving up the annual balance account; (*b*) larger allowance for waste in warehouse; (*c*) greater facilities for obtaining remission of duty on spirits lost by accident; (*d*) dispensing with certain regulations which increased the expense of making malt for distilling purposes; (*e*)) allowing the use of any materials in making wort, provided gravity of extract could be obtained by a saccharometer; (*f*) $2\frac{1}{2}$ per cent. yeast to be removed from wash; (*g*) beginning of brewing period as soon as last back of preceding period removed to wash-charger; (*h*) removal of spirits from receiver when depth amounted to 15 ins.; (*i*) limit of decrease in store raised to $1\frac{1}{2}$ per cent.

"These were embodied in an Act of 1860, which consolidated the spirit laws of the United Kingdom and removed any restriction not absolutely necessary to secure the revenue. Their being granted enabled the distillers to compete with foreigners on terms of greater equality, and thus merely carried out Free Trade principles to their logical conclusion.

"Besides settling the question of restrictions, the Act also dealt with another important matter. It became known in February, 1860, from the Chancellor's financial statement, that, owing to the commercial treaty with France, foreign spirits would be admitted for consumption into the United Kingdom at the same rate of duty as British spirits plus a small surtax of 2d. per gallon—same as that charged on Colonial spirits imported from 1848. The distillers became alarmed, as 2d. per gallon was considered an insufficient compensation for the disabilities under which they laboured. Deputations represented trade views to the Government, and put forward certain claims. It was admitted by the Board of Inland Revenue that Excise restrictions increased the cost of manufacture by $5\frac{1}{2}$d. per gallon. There was also a claim made on account of the difference in the mode of charging duty on foreign spirits, which obtained in the Customs, said to favour importers to the extent of 4d. per gallon. The full claim would not, therefore, have been met by a lower differential rate than $9\frac{1}{2}$d. per gallon.

"The restrictive operation of Excise regulations was modified by abolishing the prohibitions already detailed and granting the concessions enumerated, with the net result that 5d. per gallon was considered sufficient to meet trade claims.

"Distillers and rectifiers had established the fact that restrictions caused a loss of 2d. or 3d. per gallon, and naturally considered that they had a claim to allowance on exporting, so that they might compete with foreign distillers in Colonial and other markets. By resolution of the House of Commons, on 5th March, export allowances of 2d. per gallon on plain spirits and 3d. on compounds were granted, the duty on British spirits being raised 1d. per gallon, to make up for the decrease thus caused in the revenue. The surtax on foreign spirits was imposed at 5d. per gallon, and that on Colonial spirit continued at 2d.

"The claims advanced and allowed are shown in the schedule.

"The estimate of 1d. per gallon in the second item of the schedule was in respect of extra cost, owing to plant lying idle, repairs, lighting, coal, wages, &c. In the fourth item $1\frac{1}{4}$d. was considered an equivalent for the waste which occurs in rectifiers' stocks from the time of delivering spirits from the distillery

* 2 and 3 William IV., c. 74 (1833). † 10 Victoria, c. 6.
‡ 16 and 17 Victoria, c. 37.

until they reach the consumer. The loss is supposed to be 1 per cent.; the other 1d. is on account of being bound to use separate premises for rectifying, thus incurring expenses of rent, plant, cartage, wages, &c. The seventh item was found to be groundless. Experiments were made with a large number of consignments of foreign spirits, and it appeared that the Customs charge was rather above than below that of the Excise.

"Since 1860, the changes have been few and unimportant. They incluce (*a*) increased percentage of yeast allowed to be taken from wash; (*b*) shortening of interval between brewing and distilling periods; (*c*) extended range of warehousing strengths; (*d*) repeal of limitation as to smallest still being 40 gallons; (*e*) concessions in respect of bub, use of spent wash, yeast pressings, &c. The spirit laws were again consolidated in 1880 (43 and 44 Victoria, c. 24)."

within these walls, Professors Graham, Hofmann, and Redwood—the honoured father of him to whom this occasion is due, and whose initiative we duly acknowledge. That committee reported in favour of the employment of a mixture of ten per cent. of *purified* wood naphtha (not pure observe) so as to enable spirit to be used, duty free, without serious detriment to the Revenue. Within comparatively narrow limits in Great Britain this measure has been beneficial in its operation, in giving some (not much) encouragement to research and to manufactures (not a wide range) and in lessening the practice of illicit distillation. It is without increasing in any way illicit production or use of spirit, that we desire, under reasonable control and an extended range of denaturing agents

TABLE I.

	1866. Amount claimed by		Amount allowed in 1860.	1866. Considered by the Inland Revenue Board to be admissible.	
	Scotch Distillers.	English Distillers.		For Uncoloured Spirits.	For Coloured Spirits.
	d.	*d.*	*d.*	*d.*	*d.*
1. Compensation for duty on foreign grain	$0\frac{3}{4}$	$0\frac{3}{4}$	$0\frac{3}{4}$	$0\frac{3}{4}$	$0\frac{3}{4}$
2. Prohibition against brewing and distilling at same time	$1\frac{1}{2}$	$1\frac{1}{2}$	1	1	1
3. Against distillers mixing worts in several vessels while in process of fermentation	$0\frac{1}{4}$	$0\frac{1}{4}$	$0\frac{1}{4}$	$0\frac{1}{4}$	$0\frac{1}{4}$
4. Loss of duty on rectification and flavouring spirits in separate premises	3	3	1	$2\frac{1}{4}$	$2\frac{1}{4}$
5. Colouring matter in foreign spirits	2	2	2	Nil	$2\frac{1}{2}$
6. Increased expense in making malt consequent on Excise restrictions	$0\frac{1}{4}$	$0\frac{1}{2}$	Nil.	Nil	Nil
7. Difference in mode of charging duty in favour of foreign spirits	1		Nil.	Nil	Nil
8. Duty evaded upon foreign spirits, and by samples drawn in bond	$0\frac{1}{4}$	$1\frac{1}{2}$	Nil.	Nil	Nil
	9	$9\frac{1}{2}$	5	$4\frac{1}{4}$	$6\frac{3}{4}$

It may be well to examine definitions in view of the statement that years ago we might have had such concessions as would have at least retained a great portion of the British colour industry.

The use of methylated spirit was first allowed in 1855. It practically arose out of an application under a patent of 1853—for a lubricant as a substitute for sperm oil—for permission to use, duty free, spirit in the manufacture. This led to a series of extensive experiments by the then head of the Revenue Laboratory, Mr. Phillips, whose suggestion of *crude* wood naphtha was referred to a committee—the voices of which now hushed, have resounded

suitable to requiring industries, that we base our requests.

In the 1880 Act "methylate" means to mix spirits with some substance in such a manner as to render the mixture unfit for use as a beverage, and "methylated spirits" means spirits so mixed to the satisfaction of the Commissioners. Wood naphtha was employed then as the sole "denaturant," although the wording apparently gave latitude. Now the Customs and Inland Revenue Act of 1890—53 and 55 Vict. c. 8 section 32, (1) reads: "The substance mixed with spirits for the purpose of methylation may be *any* combination of substances approved for the purpose by the Com-

missioners; and the term 'methylated spirits' in the Spirits Act, 1880, shall, in lieu of the meaning thereby assigned to it, mean spirits mixed with *any* substance or combination of substances approved for the purpose of methylation by the Commissioners." Here is the whole point, and herewith a Table of French denaturants is given (see p. 508). Now refer to the Section 2 of Clause 32 to emphasise a point of importance in the retailing of a "methylated" or suitably denaturant spirit in case of the ultimate employment of alcohol for heating or lighting as on the Continent, where one may incidentally say that, while freedom exists careful supervision is found workable. The clause says "An authorised methylator may supply methylated spirits in vessels containing not less than a reputed quart, provided the quantity supplied by the methylator to any one person at a time is not less than five gallons." There is nothing unreasonable in this, and as a fact the distiller abroad is actually in most cases his own methylator, the distributor to wholesalers, and through them to the retailer. The denatured spirit is put into approved bottles and officially sealed and so sold. It is an offence to misuse the spirit so sold. It is true that due, but not overwhelming weight, should be given to the enormous difference between the duty abroad and here. It is incumbent on the authorities to prevent fraud by all reasonable means. Nevertheless, the limit appears to have been reached when restrictions and regulations become hindrances to industrial progress. The responsibilities of the Revenue officers are very considerable, and their responsibilities to the Treasury very great. Ultimately the Treasury would require at their hands full account, hence whatever might be admitted from our point of view, by any or all of the executive in their private capacity, officially they can but proceed cautiously, but we think there is an excess of caution, positively a hindrance. Yet, what are present day conditions, increased concessions to scientific research, to technical needs, and industrial competition on the part of our Continental rivals? As regards the first concession, thanks to the British Association Committee, absolute alcohol is permitted under quite reasonable regulations for use in approved scientific teaching laboratories. It has been so permitted because research must precede technical successes, and research logically should be along the lines of pure science with pure materials; among replies Professor Armstrong says "all research has an ultimate practical value;" other professors agree, but not one yet declares that research with pure alcohol recently conceded is being conducted with a definitely technical object. A curious reason is given that British manufacturers do not consult the purely scientific men as is done so largely in Germany. May one suggest that they step down from an assumed position of superiority, and imitate those whose scientific culture they so greatly and deservedly admire." As to the second concession, to technical needs—not the least important factor in the absence of progress in many industries, notably that of dyes and colours, whose original home was here, has been the want, not of brains and knowledge, but of cheap alcohol. I will not be tempted on this occasion into a discussion of such other deterrent factors as our educational systems, freight conditions, taxation, or patent laws. Previous reference and quotation was given of the differential duty—mentioned in the earlier Acts, 1880, 1890, and 1902—yet on this differential duty chiefly turns the question of cheapness. Revenue must be protected, and at all points. You will have noted in the quotation that what is termed "attenuation" governs initial control. "Attenuation" may and does vary with different materials, and practically with the same materials under increased knowledge of conditions of fermentation a greater "attenuation" or increase of spirit strength arises. This is within limits disregarded, because the ultimate check is the spirit condensed into the receiver—the ultimate container for the product of fermentation—therefore sedulously guarded and locked. The quotation referred to has these significant words as to concessions and dispensations—(enough are, however, left to make the distilling industry a serious business). "There were embodied in an Act (1860) which consolidated the spirits laws of the United Kingdom (different duties and regulations then existed for the different parts of the United Kingdom) and removed any restrictions not absolutely necessary to secure the revenue. Their being granted enabled the distillers to compete with foreigners *on terms of greater equality*, and thus merely carried out Free Trade principles to their logical conclusion."

Now, at this date, after the evidences of progress in the applications and uses of alcohol on the part of our rivals, what has become of equality for the users of alcohol. Admittedly, the restrictions and hindrances were, and are, so costly that the British distiller needs what is

TABLE II.—As regards France, the denaturing is effected according to the subjoined Tables. Translated by Mr. Dan Henser.

Table of the Branches of Industry for which the Employment of Denaturated Alcohol is authorised.

Branch of Industry.	Denaturing Process.	Date of the Report of the "Comité."	Remarks.
Alkaloids, digitaline atropine, santonin.	General process...	9th April 1873 9th Dec. 1874	
Aldehyde	Mix the alcohol with 10 per cent. of sulphuric acid of 66 deg. or 20 per cent. of acid of 54 deg.	13th June 1874	The mixture to be poured on bichromatic of potash.
Ethylated aniline	Mix the alcohol with hydrochloric acid and the base to be ethylated. Mix 100 litres of alcohol with 20 kilos. of hydrochlorate of aniline.	8th Dec. 1875 18th Feb. 1885 7th July 1886	
Antiseptics	General process...	11th Feb. 1891	
Camphor (Bromide of) ...	General process...	13th July 1887	
Chloral	Per litre of 95 deg. alcohol to represent 780 grms. of chloral.	2nd Nov. 1881 3rd Nov. 1886	Pass a current of chlorine through it.
Chloroform	Omission of previous denaturation. Denaturation ensues in the course of manufacture.		The alcohol is, in the presence of the officials, poured into the stills, where it is mixed with chloride of lime (5 to 6 kilos. of chloride per litre of alcohol).
Chloroferm	General process... ... ... Mix the alcohol with 10 per cent. of chloral residue.	Idem. 12th Nov. 1884	
Collodion	Mix the alcohol with an equal volume of ether and add 6 grms. of pyroxiline per litre. Per litre of alcohol of a strength of 95 deg. to represent a quantity of collodion of at least 2 litres. This collodion must contain one part of alcohol per one part of ether, and hold in solution from 12 to 15 grms. of pyroxiline per litre.	2nd Nov. 1881	
Colours obtained from coal tar.	A mixture of: 50 litres of alcohol, 50 litres of nitrobenzol or of nitrotoluol, 10 grammes of caustic soda dissolved in 20 litres of alcohol.	11th Oct. 1893	On condition of inspection by an exciseman.
Diastase.	The alcohol is added to a solution of malt	6th June 1900	Work in closed vessel. Supervision at manufacturer's expense.
Sensitive emulsion (photography).	General process...	17th July 1895	
Ether	Working up, and alcohol containing more than 1 per cent. of essential oils for the manufacture of acetic ether. Addition of 10 per cent. of residue, 10 of sulphuric acid of 66 deg. Prolonged heating at 80 deg.	1st Oct. 1899	The alcohol is produced on the spot, and the establishment subjected to permanent supervision of the officials.
Ether	The alcohol worked must be of an actual strength of at least 90 deg.	13th Dec. 1899	The proportion of methylene is calculated at the rate of 10 litres per 100 litres of alcohol at 90 deg. (90 litres of pure alcohol).
Acetic ether	A mixture of 100 kilos. of acetate of lime, and 105 litres of residues from sulphuric ether. Addition of 70 litres of alcohol.	11th May 1892	Official supervision is required.
Acetic ether	Mix alcohol of a strength 96 deg. with 40 per cent. by weight of sulphuric acid of 66 deg. and 60 per cent. by weight, of acetic acid of good odour, of 80 deg. of pure acid.	10th July 1895	
Acetic ether	Employed as a solvent for the manufacture and crystallisation of dimethyloxyquinizine (a solid chemical perfume).	...	1. The parties concerned shall, in the presence of the officials, add a proportion of 5 per cent. of residues from acetic ether coming from a preceding operation.
	First process (proportion by weight): 200 parts of acetate of sodium, say 152 kilos. 5. 131 parts of alcohol of a strength of 96 deg., say 100 kilos. 261 parts of sulphuric acid of 66 deg., say 199 kilos. Second process (proportion by volume): 20 parts of crystallisable acetic acid, good or bad taste, 95 litres. 21 parts of alcohol of a strength of 96 deg., say 100 litres. ½ part of sulphuric acid of 66 deg., say 2 litres 5.	28th July 1897	2. Samples of residues from the preparation of acetic ether shall be sent to the central laboratory of the Excise, where the most suitable product for denaturation shall be settled.
Alcoholised ether	Alcohol used for mixing of ether is liable to the consumption tax.	27th Dec. 1900	
Hydrochloric ether... ...	Mix equal weights of alcohol of 96 deg. and hydrocloric acid of 21 deg. One-third of the acid is mixed at the beginning of the operation; the two-thirds are added in proportion to distillation.	25th Jan. 1897	

Branch of Industry.	Denaturing Process.	Date of the Report of the "Comité."	Remarks.
Ether	Mix the alcohol with 10 per cent. of its volume of ether residues of type No. 3. Add to the mixture 10 per cent. of sulphuric acid of 66 deg. or 20 per cent. of acid of 54 deg.	8th Aug. 1883	Type No. 3 has been fixed by the "Comité." The process of denaturation by sulphuric acid has been authorised for manufacturers of "sulfovinates."
	Leave in the alcohol the whole of the residue of previous operations, and add 25 per cent. of crude ether.	19th Mar. 1884	
	Mix the alcohol with 15 per cent. of the ether residues and $1\frac{1}{2}$ per cent. of sulphovinic acid.	15th July 1885	The mixture is poured on an etherising base formed of 100 kilos. of sulphuric acid of 66 deg. and 60 litres of alcohol.
Ether	Mix with the alcohol half its volume of organic acids, and etherise immediately afterwards by hydrochloric gas.	14th Feb. 1894	
Ether	Acetic ether.—Mix the alcohol with 20 per cent. of residues from acetate of ethyl, and add 10 per cent. of hydrochloric acid of 21 deg.	Idem	
Ether	Hydrobromic ether (bromide of ethyl).—Mix 25 litres, of spirit strength of 96 deg., with 20 kilos. of bromine, and add subsequently to this mixture 2 kilos. of amorphous phosphorus diluted in 3 litres of alcohol of a strength of 96 deg.	25th Oct. 1881	
Ether	Mix 7 litres, 5 of spirit of a strength of 93 deg., with 8·5 litres of sulphuric acid of 66 deg. and 15 grms. of bromine.	20th Feb. 1889 15th May 1889	
Ether	Hydrochloric ether and derivatives ... Mix equal weights of alcohol of a strength of 90 deg., and of hydrochloric acid of 21 deg. Beaumé.	25th May 1883	
Ether	Hydroiodic ether (iodate of ethyline) ... Mix 6 litres of alcohol of a strength of 96 deg., 4 kilos. of iodine, and 800 grms. of amorphos phosphorus.	Idem	
Ether	Nitric ether.—Mix one part, by weight, of nitric acid of 36 deg. and four parts of alcohol of 96 deg.	25th May 1883	
Ether	Ethylate of sodium (alcohol sodé).—Mix 8 litres of absolute alcohol with 500 grms. of sodium	25th May 188[illegible]	
Sulphuric ether	No addition of residues	31st Jan. 1900	Permanent supervision at manufacturer's expense.
Fulminate of mercury ...	General process	29th July 1874 13th June 1894	
	Add to the alcohol the whole of the foul residues coming from the preceding operations.	6th Dec. 1875	
"Gazogène"	Add to the alcohol 25 per cent. of oil of turpentine and 22 per cent. of mineral oil. Add to the alcohol 40 per cent. of oil of turpentine.	23rd July 1873 23rd Oct. 1873	
"Glycérophosphate of lime"	The alcohol is added to the "glycérophosphate" dissolved in an aqueous solution of sal ammonia and sal volatile.	6th June 1900	Work in closed vessel. Permanent supervision at manufacturer's expense.
Oils (refining of)	Mix the alcohol with the oils under official supervision.	18th June 1890	Expenses for supervision payable by the manufacturer.
Essential oils	Dissolve in a hectolitre of essential oils containing less than 6 per cent. of vinic alcohol and showing at least 85 deg., 5 kilos. of resin or gum-resin, and 2 litres of nitrobenzol.	13th Feb. 1895	Used for the manufacture of varnish.
"Insecticides"	General process...	9th April 1873	
Iodoform	Idem	11th Feb. 1891	
Methylene	The quota of pyrogenous impurities has been lowered from 5 to 2·5 per cent.	25th July 1894	
Dressings (surgical) ...	Idem	21st March 1894	
Pharmaceutic extracts ...	Idem	18th Oct. 1875	On condition that the alcohol used in the manufacture shall be evaporated and not be found again in the production.
Transparent soap	General process...	2nd Nov. 1881	
Sugar (extracting sugar from molasses).	The alcohol shall be considered to be denaturated on account of the use the article is put to	26th March 1894	
Tannin	Addition of pulverised gall-nuts	27th July 1898 2nd Nov. 1898	Work in closed vessel under permanent official supervision.
"Tannins"	General process...	9th April 1873 9th Dec. 1874	
Varnish	Varnish must contain 75 grms. of resin per litre in order to have the finished and merchantable characteristics.	19th July 1899	
Varnish or tinctures for varnish	Same conditions as for surgical dressings. As regards alcohol for polishing purposes, 4 kilos. of resin or gum-resin shall be added.	13th June 1894	The same favour is granted to manufacturers of varnish for hat-making.
Malachite green	Omission	27th Oct. 1900	

NOTE.—As regards the term "General Process," it is applicable to alcohol intended for industrial purposes an transformed on the spot into finished products. It is effected b denaturing alcohol of 90 deg. strength by *approved* methylene to extent of 10 per cent. by volume.

neither more nor less than a "Protective" duty of 5d. per proof gallon—leaving him still in the position as a "methylator" (and other methylators) of having to charge to British consumers 40 per cent. more for the cheapest alcohol than our rivals pay. They have effective supervision, there is no shadow of doubt about that, but they have unlimited choice as to materials and conditions of manufacture. Indeed, the range of materials involves variety of processes and plant. There is scarcely a limit as to the size, small or great, of an installation. There is an adaptation of the principle of allowance or rebate varying with conditions, locality, material, and destination, that is, whether for colour, cleaning, power, heating, or lighting. The very transport is arranged with a view to collection of the widely spread and often small distilleries, and one result of this has been the utilisation of the produced spirits to the production of motor traction as some illustrations on the screen later will show. It should be remembered that although German distilleries are numerous. The smaller ones produce a crude spirit which is redistilled at the great distilleries or refineries. The distillation industry is necessarily a close corporation here or mainly so. It is so in Germany at least, and the "Centrale" controls everything even to the regulation and apportionment of crops, potatoes, and beet root. It is powerful enough to influence the details of legislation. But there is a difference; for making every allowance for the conditions, fiscal and otherwise, of the United Kingdom, the one aim and object abroad is the securing of national revenue through and by means of national industry. Industry first, revenue next. One need scarcely note the circumstance that national exigency demands an agrarian policy with our neighbours.

From the land to the Army, with its short service—from the Army to the land, from whence on emergency the army may be recalled. Such is the policy, and out of it the ministrations to industry spring. Frederick the Great deserves the credit for this policy, enforced by him when no united Germany existed, as now. He saw possibilities in the cultivation of the potato, which are overlooked or forgotten, and it with the later developed beet-industry are fruitful to a degree—the residues and pulps—when not utilised for cattle food, are returned to the soil, and with the saline and mineral constituents unassimilated, natural nutriment is returned to mother earth. Cheap alcohol is a necessity—whether imported or home produced—what will conduce to this? Not import duties, however justifiable; but a wider range of materials, greater freedom of processes in alcohol production, and encouragement of enterprise in home-grown amylaceous and saccharine materials. You will readily understand that a system of manufacture which defines the capacity of vessels, and the construction of distillatory apparatus — whatever may be said as to the necessity of intermediate lockings and checks—as between vats and stills—cannot easily lend itself to enterprising conditions. Yet it is a fact that locks, bolts, and bars, so to say, interpose between the parts of apparatus—the still approved for liquors from cereals cannot possibly be employed for root liquors. It should be said, that the excise may, and do, approve apparatus suitably modified—but potatoes give a shiny "wash" which is utterly unsuited to stills of the Coffey type. After all, the Americans, as usual, while at present in the same boat as regards permission to use spirit industrially, and indeed, a worse one, fiscally considered, have dispensed with much of the internal and minute supervision, and are satisfied with a control which carefully estimates the composition and weight of the material going into the distillery, and as carefully weighs the ultimate alcoholic product. Cannot a similar system prevail here? Are we less earnest or loyal than our Transatlantic cousins? While it is true they labour under intolerable conditions as to the use of alcohol, a point made clear in my paper of March last, the movement for industrial use is gaining ground there, and it is a probability of the future, that concessions we ask for, will be granted them sooner than to us, then again we shall experience the charms of "dumping" products we *can* make and of being deprived of the advantages of a force we cannot economically employ. The movement for cheap industrial alcohol is widespread, and refusal to note its extension and incidence is at least unwise. You may be unaware that by the Act of 1876—an old one—the Customs have power to impose duties on imported spirit and spirituous preparations—or substances in the manufacture of which alcohol has been employed and to the extent of the alcohol so employed. Now few, if any, such substances can be manufactured without waste of alcohol. Under this Act, duties can be imposed not only on the contained alcohol, but on the wasted alcohol. Only a few substances, happily, are so taxed, such as ace-

tic, butyric, sulphuric ethers, ethyl bromide, and chloride; and transparent soap. This does not appear a formidable list producing £3,000 or thereabouts of duty. But there is no legal preventative for an extension of the list. As a matter of fact, most of the new remedies of a synthetic order, such as antipyrin and phenacetine, have been prepared either from or with alcohol. At least, purification has been made with it. Table III. gives a few such substances. Probably one-fifth of similar bodies sold require alcohol in manufacture. Our Customs

TABLE III.

A Few Substances, the manufacture of which could be greatly extended by means of Alcohol, UNDENATURED, *or, if inevitable,* SUITABLY DENATURED.

Tannic acid.	Pancreatin.
Gallic acid.	Pilocarpine.
Atropine.	Thymol.
Aconitine.	Salicylates.
Agaricine.	Aldehyde.
Berberine and salts.	Paraldehyde.
Cantharidine.	Bromoform.
Coniine.	Iodoform.
Cannabin tannate.	Ethyl chloride.
Cocaine.	Ethyl bromide.
Emetine.	Ethyl iodide.
Ergotine.	Ethyl acetate.
Eucaine.	Ethyl benzoate.
Gelsimine.	Ethyl formate.
Hydrastine.	Chloral hydrate.
Hyoscyamine.	Pure caustic alkalis.
Hydroquinone.	Oleoresin of capsicin.
Iridine.	Oleoresin of gingerin.
Jalapine.	And many alkaloids and
Santonine.	fine chemicals.

Authorities have evidently observed that to impose duties to the extent indicated, whilst none or few facilities existed for the use of suitably and matured alcohol—and many of these bodies were made by processes patented but not worked in Great Britain—was in restraint of trade, Great Britain, then and now, was doing the largest over sea trade. The law is there, but we submit that to put its provisions widely into force, would do no good to anybody but our rivals. If it should be done at all, then we can manufacture in equal terms with our rivals. Tables IV., V., and VI., show many substances in which the radical ethyl or methyl (pure methyl being taxed equally with pure alcohol) exists as a necessary component, shown by the thickened line.

TABLE IV.

A FEW EXAMPLES BY PROF. A. G. GREEN.

The alcoholic parts of the molecules are indicated by a thick underline.

Chrysophenine.—Sodium salt of disulphostilbene-disazophenol ethoxy-phenol—

$$\begin{array}{l} CH.C_6H_4(SO_3Na).N_2.C_6H_4OH \\ \| \\ CH.C_6H_4(SO_3Na).N_2.C_6H_4\underline{OC_2H_5} \end{array}$$

Dianisidine Blue.—Dimethoxyl - diphenyl - disazo beta-naphthol—

$$\begin{array}{l} C_6H_2(\underline{OCH_3}).N_2.C_{10}H_6OH \\ | \\ C_6H_2(\underline{OCH_3}).N_2C_{10}H_6OH \end{array}$$

Rhodamine. — Diethyl meta amido phenol-phtaleine.

$$Cl(\underline{C_2H_5})_2N:C_6H_2\left\langle\begin{array}{c} O \\ C \end{array}\right\rangle C_6H_3N(\underline{C_2H_5})_2 \quad -C_6H_4.CO_2H$$

Paris Violet.—Pentamethyl-Pararosaniline—

$$C\begin{cases} C_6H_4.N\underline{CH_3} \\ = C_6H_4:N(\underline{CH_3})Cl_2 \\ C_6H_4.N(\underline{CH_3})_2 \end{cases}$$

Messrs. Brooke, Simpson and Spiller consider the matter of free, suitably denatured alcohol of the very highest importance.

Messrs. Levinstein and Co. contribute the following list:—

ANILINE DYESTUFFS.

Alkylating Agents.

Methyl chloride.	Ethyl chloride.
Methyl bromide.	Ethyl bromide.
Methyl iodide.	Potass ethyl sulphate.
Dimethyl sulphate.	

Alkylated Intermediate Products.

Monomethylaniline.	Mono-ethylaniline.
Monomethyl-*o*-toluidine.	Mono-ethyl-*o*-toluidine.
Monomethyl-*p*-toluidine.	Mono-ethyl-*p*-toluidine.
Monomethyl-α-naphthyl-amine.	Mono-ethyl-α-naphthyl-amine.
Monomethyl-β-naphthyl-amine.	Mono-ethyl-β-naphthyl-amine.
Dimethylaniline.	Methylethylaniline.
Dimethyl-*o*-toluidine.	Methylethyl-*o*-toluidine.
Dimethyl-*p*-toluidine.	Methylethyl-*p*-toluidine.
Dimethyl-α-naphthyl-amine.	Methylethyl-α-naphthyl-amine.
Dimethyl-β-naphthyl-amine.	Methylethyl-β-naphthyl-amine.
Diethyl-*o*-toluidine.	Diethyl-α-naphthylamine.
Diethyl-*p*-toluidine.	Diethyl-β-naphthylamine.

and very many other secondary and tertiary amines, and also substituted amines, such as the very important dimethyl-*m*-amidophenol and diethyl-*m*-amidophenol, the base of the rhodamines.

Among dyestuffs prepared from these or similar alkylated intermediate bodies are pyronine, rhodamines, brilliant green, malachite green, methyl violet, gallocyanine, patent blue (replacer of indigo extract), Nile blue, Capri blue, &c., &c.

Dyestuffs prepared by directly alkylating the finished products: Congo orange, cotton yellow, thioflavine, certain acridines, and, very important, chrysophenine.

MANY PHARMACEUTICAL PRODUCTS. (See List.)

SYNTHETIC PERFUMES AND ESSENTIAL OILS.

Heliotropin. Vanillin, Artificial Musk, Ionone, and Neroli Oil.

Dr. Chas. Dreyfus, Clayton Aniline Co., contributes as follows:—

DIRECT COTTON COLOURS.

Yellows.

Chrysopheninediamine. Sodium salt of diaminostilbene-disulphonic acid disazophenolphenetol.

Golden yellow.

Orange.

Congo Orange:—

I. Sodium salt of benzidinedisazo-2-naphthylamine-3.6-disulphophenetol.

II. Sodium salt of tolidinedisazo-di-1-naphthylamine-3.6-disulphophenetol.

Reds.

Benzopurpurin 10 B.

Sodium salt of dianisidinedisazo-di-1-naphthylamine-4-sulphonic acid.

Diamine Reds and Scarlets:—

I. Sodium salt of benzidinedisazodisalicylic acid-2-aminonaphtholsulphonic acid-7. (Red.)

II. Sodium salt of benzidinedisazophenetol-2-naphthol-β-8-disulphonic acid. (Scarlet.)

Blues.

Chicago Blue B.—Sodium salt of dianisidinedisazo-di-aminononanaphtholsulphonic acid S.

Chicago Blue 6 *B.*—Sodium salt of dianisidinedisazo-diaminonaphtholdisulphonic acid S.

Diamine Blue B.—Sodium salt of ethoxybenzidinedisazo-2-naphthol-2.7-disulphonic acid-1-naphthol-4-sulphonic acid.

Diamine Blue 3 *R.*—Sodium salt of ethoxybenzidinedisazo-di-1-naphthol-4-sulphonic acid. (Sky blue.)

BASIC AND MORDANT COLOURS.

Yellow.

Tartrazine.—Di-sodium salt of 1-*p*-sulphoxyphenyl-3-carboxyl-3-*p*-sulphoxyphenyl-hydrazone-3-pyrazolone.

Reds.

Rhodamine.—Phthaleïn of diethyl-*m*-aminophenol (basic hydrochloride).

Eosines, S.—Potassium salt of tetrabrom-fluoresceïn ethyl ester.

Safranines.—M S phenyl- or tolyl-diamino tobazonium chloride.

Blues.

Methylene Blue.—Hydrochloride of tetramethyl-diamino-phenazthionium.

Capri Blue.—Zinc chloride double salt of diethylamine toludimethylaminophenoxazonium chloride.

Night Blue.—Hydrochloride of tolytetraethyltriamino-α-naphthldiphenyl carbidride.

Gallocyanine.—Dimethylaminohydroxyphenoxazone carbonic acid.

Violets.

Hofmann's.—Triethylrosaniline.

Paris.—Hexamethylpararosaniline hydrochloride.

Greens.

Malachite.—Zinc double salt of tetramethyl-di-*p*-aminortriphenyl carbidride.

Brilliant.—Sulphate of tetraethyl-di-*p*-aminotriphenyl carbidride.

Messrs. Claus and Rée, Read Holliday and Sons, Messrs. Sadler and Co., and other well-known firms confirm the above.

Particulars of the consumption of alcohol in colour works, voluntarily afforded, for the year 1897:—

A	1,250,000 litres (methyl and ethyl).	
B	3,000 kilos.	
C	60,000 kilos.	ethyl.
	60,000 ,,	methyl.
D	30,000 ,,	ethyl.
	50,000 ,,	methyl.

According to the Verein zur Wahrung der Interessen der chemischen Industrie Deutschlands, the total consumption of ethyl alcohol for dye manufacture in Germany was, in 1897, 1,100,000 kilos. It is probable, however, that it is now double this.

It is stated the Badische Anilin und Soda Fabrik use 90 to 100,000 kilos. of ethyl chloride per annum, and there is reason to believe that not one kilogramme is made in England for this purpose. The price of production is stated to be, say, 10d. to 1s. a kilogramme; here 19s. a gallon is payable as duty.

Efforts have been made by more than one firm to manufacture this useful refrigerant and synthetic agent under the recent Finance Act of 1902, but without avail.

This is illustrated further in Table V., in which the first column gives the common name, the second the chemical name, the third the formula, and the outer two columns the percentage of combined ethyl and methyl as their respective alcohols. Table VI. shows a further number of substances in which the alcohol is a necessary factor, although decomposed. Now the spirit of the 1876 Act implied a levy on the entire employed alcohol. The practice of the Excise authorities has not, as a rule, been to recognise waste as such. They could scarcely do so since experience of actual working has been rare; but our rivals have recognised this, and also the correlative

fact of recovery of spirit in manufacture. I am unaware of a sanctioned case of spirit recovery in technical work. You will see, however, how exceedingly important this may be, and even imperative from an economic point of view. The dearer the spirit the greater the need for saving: the fallacy is that rectification is assumed in spirit recovery. There would, in practice be few cases in which any purification could occur—rather the reverse. Now Table VII., A. and B. shows in A. a few colours, with the percentages of alcohol and methyl, with wholesale price per pound, side by side with the duty which would have been paid had the cost of 1876 been put in force. Now in B, we have side by side the foreign

TABLE V.

SOME SUBSTANCES WHICH HAVE ETHYL OR METHYL AS A NECESSARY COMPONENT.

			Percentage of combined Ethyl as Alcohol.	Percentage of combined Methyl as Methyl Alcohol.
Acetal	Ethylidene-di-ethyl-ether	$CH_3 - CH(OC_2H_5)_2$	78	
Ethyl chloride	.. .. ..	C_2H_5Cl	71	
,, bromide	.. .. ..	C_2H_5Br	42	
,, iodide	.. .. ..	C_2H_5I	12	
,, formate	.. .. ..	$HCOOC_2H_5$	62	
Holocaïne	Para - diethoxyethenyldiphenyl - amidine-hydrochlor.	$(OC_2H_5C_6H_4NH.C.CH_3 : N.C_6H_4OC_2H_5)HCl.$	27	
Homoarecolin	Methyl-tetra-hydro-nicotinic acid	$C_7H_{10}.(C_2H_5)NO_2$	27	
Mercury ethyl chloride	.. .. ..	HgC_2H_5Cl	17	
Phenacetin	Para-oxyethylacetanilid	$C_6H_4 \left< \begin{matrix} OC_2H_5 \\ NH.CH_3CO \end{matrix} \right.$	26	
Tetra ethyl ammoniun hydroxide	.. .. ..	$N(C_2H_5)_4OH$	12·5	
Tetronal	Diethylsulphonediethylmethane	$(C_2H_5)_2.C.SO_2(C_2H_5)_2$	96	
Anæsthesin	Ethylesterpara-aminobenzoic acid	$C_6H_4NH_2COO.C_2H_5$	28	
Subcutin	Anæthesin-paraphenolsulphonate	$C_6H_4NH_2.COO.C_2H_5\ HO.C_6H_4\text{-}SO_3H$	13·5	
Codethyline	.. .. ..	$C_{17}H_{17}ON[OH][OC_2H_5]$	21·6	
Dionine	Ethyl-morphine-hydrochloride	$(HO.C_{17}H_{17}.NO.OC_2H_5.HCl$	13	
Valyl	Valeric acid diethyl-amide	$(C_4H_9CO.N(C_2H_5)_2)$	59	
Eupyrin	Para - phenetidine - vanillin - ethyl carbonate	$C_6H_4(CC_2H_5).N.CH.C_6H_3\text{-}(OCH_3)O$	18	
Malarin	Acetophenone-phenetidine citrate	$C_6H_4 \left< \begin{matrix} OC_2H_5 \\ N = C(CH_3)\ (C_6H_5(H_3C \end{matrix} \right.$	18	25
Malakin	Salicyl-paraphenetidine	$C_6H_4(OC_2H_5.)N : CH : C_6H_4(OH)$	19	
Sulphonal	Diethyl-sulphonedimethyl-methane	$(CH_3.)_2C.(SO_2.C_2H_5)_2$	40	28
Sulphaldehyde	.. .. ..	.. .. ..		
Saliphonin	Salicyl-para-phenetidine	$C_6H_4(OC_2H_5)NH.C_6H_4(OH)CO$	20	
Thymacetin	.. .. ..	$\left. \begin{matrix} CH_3 \\ C_3H_7 \end{matrix} \right> C_6H_2 \left< \begin{matrix} OC_2H_5 \\ NH.(CH_3CO \end{matrix} \right.$	22	15
Urethane	Ethyl-carbamate	$CO \left< \begin{matrix} NH_2 \\ OC_2H_5 \end{matrix} \right.$	52	
Bromalin	Brom-ethyl-formine	$(CH_2)_6NHC_2H_5Br)$	22	
Euchinin	Quinine-ethyl-carbonic-ester	$(C_2H_5OCO.OC_{20}H_{23}N_2O)$	11·6	
Methyl chloride	.. .. ..	CH_3Cl		63
,, bromide	.. .. ..	CH_3Br		53·7
,, iodide	.. .. ..	CH_3I		22·5
,, loritin	Para-methylmetaiodoortho-oxy-quinoline-ana sulphonic acid	$CH_3I.OHC_9H_3N.SO_3H.H_2O$		8
,, urethane	Urethylan	$C - O.OCH_3$		42·5
Methacetin	Para-oxy-methyl-acetanilide	$C_6H_4OCH_3.NH.CH_3CO$		20·6
Methonal	Dimethylsulphonedimethyl methane	$(CH_3)_2C.(SO_2CH_3)_2$		64
Methylal	Methylene-dimethyl-ether	$CH_2.O(CH_3)_2$		50

TABLE VI.

Some Substances in which Alcohol is a necessary Factor though being Decomposed.

			Percentage Ethyl Alcohol.	Percentage Methyl Alcohol.
Chloroform .. Where not	.. .. ..	$CHCl_3$	37·4	
Iodoform .. made from	.. .. ..	CHI_3	12·7	
Bromoform .. acetone	.. .. ..	$CHBr_3$	49·5	
Chloral orthoform	Chloral - amino - hydroxy-benzoic-methyl-ester.	$C_6H_3(COOCH_2).OH.N.CH.CCl_3$	15·5	10·8
Nirvanin	Diethyl - glycocoll - para-amino-hydroxy-benzoie-methyl-ester.	$HCl.(.(C_2H_5)_2.N.CH_2.CO.N.H.C_6H_4(.OH)COOCH_2$	29	10
Eugenol acetamide	.. .. ..	$CH_3C_3H_5(OCH_3)OCH_2CONH_2$	20·8	
Methenyl	Para-phenetidine	$C_2H_5OC_6H_4NH.CH.N.C_6H_4OC_2H_5$	32·5	
Hydrochloride of diacetic ester of morphine.	.. .. ..	.. ..		
Diacetyl morphine	.. .. ..	.. ..		
Chloral ammonia	.. .. ..	$C.Cl_3CH(.OH)NH_2$	28	
Chloralamide	.. .. ..	$CCl_3.CH(OH)NH.CHO$	24	16·6
Dormiol	Dimethyl-ethyl-carbinol ..	$C_2Cl_3CH(OH)OC(CH_3)_2C_2H_5$	18	23·5
Chloral acetophenone oxime .	.. .. ..	$C_6H_5C.(CH_3)NO.CHOH.CCl_3$	15·7	
Iodoformel	.. .. ..	.. ..		
Forman	Chloro - methyl - menthyl-ether.	$C_{10}H_{19}O.CH_2Cl$	..	16
Thymyloform	.. .. ..	$[C_6H_3(CH_3.)(C_3H_7)O]CH_2$	..	20
Polyformin	Diresorcin - hexamethylin-teramin.	$(C_6H_4(OH_2)_2.-(CH_2(_6N_4$	..	53
Galloform	Hexamethylene - tetramin-gallic-acid.	$[C_6H_2.(OH.)_3COOH\ (CH._2)_6N_4.]$	..	53
Mercuric formamide	.. .. ..	$(HCO.NH_2)Hg$	..	13
Guiaform	Methylene-diguaiacol	$(CH_2[C_6H_3(OH)OCH_3.]_2$	..	12
Guaethol	Mono-ethyl-ether of guaiacol.	$C_6H_4\left\langle{}^{OC_2H_5(1)}_{OH(2)}\right.$	33	
Tannoform	Methylene ditannin	$CH_2(C_{16}H_9O_9)_2$	13	
Tannocasium	.. .. ..	.. ..		
Cetarin	Anhydro - methylene - citrate of sodium	$(NaOCO.CH_2(_2CO\left\langle{}^{CH_2}_{CO}\right\rangle O$	13	
Caffeine ethylenediamine and similar caffeine substitution products and derivatives				

TABLE VII. (A).

Contributed by A. G. Green, Professor of Tinctorial Chemistry, Yorkshire College, Leeds.

Name of Dyestuff.	Percentage of Methyl Alcohol.	Percentage of Ethyl Alcohol.	Price per lb. (wholesale) for pure Product.	Unpaid Duty per £100 value.	Estimated Annual Imports.
			s. d.	£	
Malachite green	27	..	2 3	34	10 tons
Methyl violet	40	..	1 6	75	Difficult to estimate
Gallocyanine	21	..	2 0	30	5 tons (?)
Methylene blue	33	..	3 6	26	Difficult to estimate
Auramine O	40	..	1 11	59	45 tons
Victoria blue R	28	10	1 10	59	30 ,,
Brilliant green	..	38	2 3	48	10 ,,
Patent blue V	..	34	2 3	43	45 ,,
Rhodamine B	..	38	5 0	21	15 ,,
Rhodamine 6 G	..	30	20 0	4	30 ,,
Chrysophenine	..	13	1 8	22	Difficult to estimate, but very large.

TABLE VII. (B).

Table showing Spirits used per £100 Import Value. P. Leuthardt-Thornton.

Product.	Import Price per lb.	Weight per £100.	Alcohol 95 per cent. used				Methyl Alcohol used		
			in 1 lb. Finished Product.	for £100 Import Value.	Foreign Value of Alcohol, 1900.	English Value per £100.	in 1lb. Finished Product.	for £100 Import Value.	Value of Methyl Alcohol.
	s. d.	lb.	lb.	lb.	£ s. d.	£ s. d.	lb.	lb.	£ s d.
Antipyrine	5 6	364	0·933	339	2 16 6	34 12 2	0·448	163	4 8 3
Ethel chloride ..	0 11	2,182	1·00	2,182	18 3 6	222 2 10	..	..	..
Phenacetine	3 0	667	2·082	1,389	11 11 6	141 15 10	..	..	..
Salipyrine	5 0	400	0·89	356	2 19 4	36 6 10	0·288	115	3 2 3
Dermatol	0 15	133	2·13	283	2 7 2	28 17 9	..	..	..
Salol	0 10	200	2·3	460	3 16 8	46 19 2	..	..	..
Heliotropine	12 6	160	0·506	81	0 13 6	8 5 5	..	..	..
Vanilline........	12 6	160	1·603	256	2 2 8	26 2 8	..	..	..
Kryofine	21 0	95	1·63	155	1 5 10	15 16 6	1·474	140	3 15 10
Guaiacol carbonate	11 0	182	6·63	1,206	10 1 0	122 2 3	2·77	504	13 13 0
Dimethylaniline .	0 10	2,400	..	..	..	..	0·676	1,622	43 18 7
Gallocyanine, 10 per cent.	0 5	4,800	..	..	..	..	0·174	835	22 12 3
Gallocyanine powder	4 4	461	..	..	..	..	1·683	776	21 0 4
Gallopurple	5 6	364	..	..	..	..	2·67	792	26 6 6
Tartrazine	1 6	1,334	0·233	311	2 11 10	31 15 0	..	..	..
Chrysophenine ..	1 6	1,334	0·209	278	2 6 4	28 17 6	..	..	..
Dianisidine base	5 6	363	0·82	298	2 9 8	30 8 3	..	..	..
Ketone	2 6	800	..	..	..	..	1·24	992	26 17 4
Methane base....	..	..	0·11	..	..	..	0·71	..	..
Auramine O	2 3	888	0·109	97	0 16 2	9 18 0	0·704	625	16 18 6
Victoria Blue B..	1 9	1,143	..	..	..	..	0·496	566	15 6 7
,, ,, 4 R	2 0	1,000	..	..	..	..	0·7125	712	19 5 11
Benzopurpurin 10 B	2 6	800	0·19	152	1 5 4	15 10 5	..	..	..
Rhodamine B ..	4 0	500	0·045	22	0 3 8	4 4 11	..	..	..
,, G ..	5 0	400	0·047	19	0 3 2	1 18 9	..	..	..
,, 6 G	6 0	334	0·764	255	2 2 6	26 0 7	..	..	..
Dimethyl acid....	..	..	..	..	..	..	0·548	..	..
Rhodine 6 G R..	6 0	334	1·76	588	4 18 0	60 0 6	..	..	..
,, 11 G ..	6 0	334	0·448	150	1 5 0	15 6 4	0·114	38	1 0 7
,, 12 G ..	6 0	334	0·55	184	1 10 8	18 15 8	0·14	47	1 5 5
,, 12 G F .	6 0	334	0·626	209	1 14 10	21 6 8	0·476	159	4 6 1
,, G W ..	6 0	334	..	..	.	..	0·719	240	6 10 0
,, 3 G W .	6 0	334	0·114	38	0 6 4	3 17 7	0·425	141	3 16 4
,, 12 G M .	6 0	334	0·4	133	1 2 2	13 11 6	0·109	36	0 19 6
,, 3 G	6 0	334	0·074	25	0 4 2	2 11 0	0·268	90	2 8 9
Methylene Blue..	2 6	800	..	..	..	..	0·981	785	21 5 2
Crystal Violet ..	3 6	571	..	..	..	..	0·754	430	11 13 11
Vert pour Noir ..	6 0	334	..	..	..	..	0·223	74	2 0 1
Indazurine B	1 9	1,143	0·075	86	0 14 2	8 13 6	..	..	..
,, G M .	2 0	1,000	0·104	104	0 17 4	10 12 6	..	..	..
,, B B ..	2 0	1,000	0·1	100	0 16 8	10 4 2	..	..	..
,, G ..	2 0	1,000	0·09	90	0 15 0	9 3 9	..	..	..
,, N G..	2 0	1,000	0·092	92	0 15 4	9 7 10	..	..	..
,, 5 G M	2 0	1,000	0·66	66	0 11 0	6 14 9	..	..	..
Direct Violet B B	2 0	1,000	0·11	110	0 18 4	11 4 7	..	..	..
Direct Blue 6 B	2 0	1,000	0·068	68	0 11 4	6 18 9	..	..	..
,, ,, 7 B..	4 0	500	0·0602	31	0 5 2	3 3 3	..	..	..
Rhodine B S.....	6 0	334	0·338	113	0 18 10	11 10 8	0·265	89	2 8 2
Tartrachromine G G	3 0	667	0·55	367	3 1 5	37 12 5	..	..	..
Dioxyrubine G ..	2 3	889	0·852	575	6 6 2	77 5 6	..	..	..
Rhodine 5 G	6 0	334	0·174	58	0 9 8	5 18 5	0·2462	82	2 4 8
Phenocyanine 10 per cent.	1 0	2,000	0·139	278	2 6 4	28 7 7	..	..	..

value of alcohol in 1900 for a given weight with the British equivalent value. Take one familiar substance only, the well-known phenacetine — its import price was 3s. per lb., the value of the alcohol used—not contained—for £100 import value 1,389 lbs., foreign value £11 11s. 6d., British value of alcohol per £100 = £141 15s. 10d. Look into the detail of this production. In its three stages you will notice that at each stage there is a return; that is a recovery.

PHENACETINE.

(*a*) 5,765 lb. nitrophenetol require—

2,745 lb. ethyl chloride	2,745 lb. alcohol	95	per cent.
In addition....	4,576	,,	,,
	7 321	,,	,,
Less returned..	3,850	,,	,,
Nett used	3,471	,,	,,
For 1 lb. nitrophenetol	0·602	,,	,,

(*b*) 4,048 lb. phenetidine require—

5,808 lb. nitrophenetol at 0·602 lb...	3,496 lb. alcohol	95	per cent.
In addition....	6,0[illegible]8	,,	,,
	9,594	,,	,,
Less returned .	4,510	,,	,,
Nett used	5,084	,,	,,
For 1 lb. phenetidine..	1,255	,,	,,

(*c*) 5,214 lb. phenacetine require—

4,158 lb. phenetidine at 1·255 lb...	5,218 lb. alcohol	95	per cent.
In addition....	10,340	,,	,,
	15,558	,,	,,
Less returned: 66 lb. phenetidine at 1,255 lb... 86			
Further 4,620	4,703	,,	,,
Nett used	10,855	,,	,,
1 lb. phenacetine	2,082	,,	,,

£100 import value at 3s. per lb. = 667 lb., for which were used 1,389 lb. alcohol 95 per cent. at 2d. = £11 11s. 6d.

Perhaps one more illustration of a different class of body may be given—no other indeed than the desirable chemical ethyl chloride, already referred to; £18 3s. 6d. is the foreign equivalent of £222 2s. 10d. British value, of alcohol required. For the sake of accuracy and record it should be said that Mr. Leuthardes-Thornton's figures are in prices in 1900 according to the statement below. To-day for 95 per cent. alcohol—overproof—the British duty-paid price is 2s. 7d. per lb. and you cannot get it unless duty paid.

ALCOHOL, 1900.

The quantities here given have been actually employed in manufacture, the prices being those ruling in 1900:—

Alcohol 95 per cent. at 2d. per lb.

Alcohol 100 per cent. at 2 $2\frac{1}{4}$ per lb.

Methyl alcohol at 6·5 per lb.

Alcohol 95 per cent. is generally used, also in some cases alcohol 100 per cent.

1.345 lb. alcohol 100 per cent require—
1,762 lb. alcohol 95 per cent
of which are returned .. 323 lb.

or nett.......... 1,439 lb. at 2d. = £11 19s. 10d

1 lb. alcohol 19 per cent. therefore costs 2·14d.

Now we have dwelt strongly on the chemical side of the case; not by any means to urge that the existing, but old law be enforced, but to urge that while its object was obviously for the prevention of fraud on the revenue it should not now be enforced, when the trade has been developed in the days of its non-employment, but that facilities should be given to produce not only alcohol but its derivatives and products on equal terms with our rivals. When equalisation of conditions exists, then we can usefully employ a dormant force. Now, does the Finance Act of 1902 really assist? One cannot deny that it has assisted in some cases where denatured spirit is required in large quantities, and where supervision can be at once complete and not too costly; as now in the manufacture of mercury fulminate within the United Kingdom; as in the production of celluloid and in the desiccation of nitro-cellulose smokeless powders. But the 1902 Act, while emphasising the important principle of State recognition of industrial alcohol, suitably denatured, left its administration in the hands of that very able body of civil servants, the Excise Officers of Inland Revenue, who have imposed upon them as their first duty, the conservation of a revenue of many millions, and are not inspired by a regard for industrial progress as the first principle. The Act needs administering in the direction of a liberal interpretation, and it needs amending in that still more important direction of the removal of the whole or greater part, as each industry may require, of the differential duty — formerly 4d. per proof gallon; now, as a consequence of the corn duty no longer existent, of 5d. per proof gallon. This is heresy indeed, for I for one declare an opinion against freeing imported spirit,

even for methylating or other form of denaturing from this impost, and why? Because distillers, for hindrance in whose business it was put on, have openly declared their willingness to be without its advantage; and, thereby, the inevitable over-production of spirit under existing circumstances would be absorbed by native industries and consumption. "Duty-free" is a partial misnomer, as applied to British denatured spirit. What is wanted is permission to employ "untaxed" alcohol under proper supervision and guarantees in syndicated or combined manufactories in bond if necessary rather than not at all, as now. The principle of waste and the practice of recovery in working processes must be recognised and allowed for. Allowance for taste has long been recognised, and the concessions on exporting tinctures and perfumes, where waste-duty (fiscal and differential), and even error in analysis is allowed for. The concession, under guarantees, for experimental work with denatured alcohol in a large scale must be conceded. It is a fact that such concession are constantly refused — partly, no doubt, because of an out of date fear of fraud, and partly because to that extent the element of magnitude expressly mentioned in the regulations is sued—for the administration of Clause 8 of the 1902 Act is absent.

"Cast to the winds thy fears" occurs in an ancient poem composed for the behoof of the timid and cautious. May we commend it to our administrators.

Our alcohol is not "potential whisky," as Dr. T. E. Thorpe, the head of the Government laboratory himself wrote so recently as March last. The same pen wrote also "that Government departments existed for the public good." His next in command (since retired) I mean Mr. Helm, D.S.O., on the same occasion made a most important suggestion in the discussion. He said he did not see why measures should not be taken to cheapen methylated spirit. He thought it would be a great benefit to get methylated alcohol as cheap as abroad, for it would be a great benefit. He thought they might fairly go to the Chancellor of the Exchequer and propose that he (the State) should pay the cost of denaturing; it was denatured for Revenue protection, why should not the Revenue bear the charge? If he could give the differential duty back in the alcohol in methylated spirit, why should not he allow the differential duty in alcohol used for manufacture in this country, whether as ordinary alcohol or as methylated, that is denatured spirit? So far Mr. Helm. Anything that improved the general trade of this country improved the consumption of potable spirit. They had, Mr. Helm intimated, knocked repeatedly at the door of Inland Revenue, but it was now the wrong door. In 1902 the right door became that of the Treasury and the Chancellor of the Exchequer. If the Chancellor wanted advice, Mr. Helm assured us that we should have sympathy from them. Mr. Helm concluded by indicating how narrow were the limits within which it would be safe for the Revenue to allow duty-free alcohol, and he advised us to combine with it a claim for reduction in the cost of methylated or denatured spirit. Really there must be some confidence placed in decent people who gave competent assurances and guarantees. Now it turns out that even on the Continent, in Germany, where the aniline dye industry excites our admiration, not to say, envy, its development has not—great as it is—kept pace with the production of alcohol. Outlets had to be found, and the shrewd Government there saw the continuance of its agrarian policy in the extended employment of denatured alcohol for motive power, lighting, and heating. The "Journal of the Automobile Club," 100-101, vol. vii., of March 31st last, contains a paper by Dr. Ormandy, of Messrs. Jas. Crosfield and Son, Warrington, devoted mainly to the use of alcohol for motors. As a fact, the chief material for this evening's paper was compiled from the reports and publications of the German Central Spirit Combination. But my good friend, Dr. Boverton Redwood, having occasion to see Dr. Ormandy and a colleague—Mr. Allan—suggested alcohol as a motive power worth consideration. Dr. Redwood is the cause of my being here to-night, but he did not know how he was inadvertently directing a species of sand blast on my acquired stores of material taken from the reports and discussions of the German Verein. I will therefore content myself with abstracting to Dr. Ormandy's paper, and the very useful discussion thereon. Dr. Ormandy quite rightly utilised some of the paper read before the Society of Chemical Industry in March, and I reciprocate the compliment and abstract enough of his paper to indicate the points, and thank Messrs. Crosfield for the use of diagrams illustrating the comparative increases of alcohol consumption:—

But of course the main lesson was the demonstration of alcohol—untaxed and free—as an economical

source of motive power. Early experiments were not over promising as compared with petrol, which is obtainable of proper quality only to the extent of 2 per cent. of the petroleum distilled, and which, in consequence of the demand in America itself for power, is becoming scarcer and dearer. The consumptions on an older type of motor were respectively 426 and 839 grammes per b.h.p., corresponding to efficiencies of 13·6 and 12·2, the former a fair result for a more up-to-date petroleum engine. Then, with a special carburettor, came a Köinting motor only consuming 550 grammea per b.h.p. Why was alcohol so neglected as a source of power for internal combustion engines when an outlet for alcohol was required? The answer is that in a consideration of the relative heats of combustion compared with competitors, the heats of combustion of alcohol was 5,500 and petrol 10,250 calories—hopeless unless the price of one was half the other. But the value of a fuel is not so measured. Dependence is placed in the number of calories which can be converted into work. Efficiency of $12\frac{1}{2}$ per cent. was produced later as the result of experiment, and adoption of space and cylinder 33 to 30 per cent. was extracted. Compression resulting from the heat was much higher than with petrol-driven motors. Sometimes ten atmospheres were given, and as high as 33 atmospheres was attained in some cases. The higher efficiency in alcohol motors is due almost entirely to this high compression. As is well known, this high compression can only be used within low limits in the case of petrol. The temperature which a mixture of gases attains upon compression depends largely upon the specific heat of the substance in the mixture. In the case of alcohol (commercial), we have to remember that there is 10 per cent. of water, which obviously allows of greater compression. In certain motors by the injection of water (atomised) with the paraffin 10 atmospheres were safely obtained, whereas with no water four to five atmospheres only is permissible. So that according to the highest authorities the increased efficiency of an alcohol motor is due, firstly, to the low inflammability of alcohol air mixtures, and secondly, and in a higher degree, to the water contained in the alcohol. These considerations affect the construction of motor engines, and obviously so long as alcohol here was dear, and so dear, there was no reason why structural alterations and especially considerations of weight should prevail. It would at first sight be seen that the water would be a serious obstacle to the use of alcohol for motors, but if the actual amount of heat which is necessary to evaporate a certain quantity of alcohol containing 10 per cent. of water is considered, it will be found that it amounts to only $5\frac{1}{2}$ per cent. of the total heat of combustion of that same amount of alcohol (the heat which would be given out by the water vapour in products of combustion condensing from the form of steam is not taken into consideration). This $5\frac{1}{2}$ per cent. of heat needed to convert the alcohol into vapour can easily be abstracted from the exhaust gases of the motor, or from the water taking away heat from the cylinder walls.

Dr. Ormandy here pointed a resemblance to the chain of operations taking place in a modern blast furnace, where the exit and once-waste gases from the furnace are now used to heat up the air fed to the bottom of the same or, as in the Siemens regenerative furnace, where high temperatures and great economy are attained by similar means.

As Dr. Ormandy points out, knowledge of conditions is necessary, and the science of motor power is the science of physics, saturation equivalents for alcohol and water for air, specific heats, heat of combustion, and so on. Yet, taking all into account, alcohol, of course at a price, runs petrol too close to be pleasant. Yet it is pleasant for alcohol since there is no disagreeable and nauseating smell and no clogging of parts. The combustion of alcohol is complete. An important point is that alcohol is less volatile than petrol, and is, therefore, much less likely to be a source of accidental fire. The storage need not be the subject of such stringent conditions as petroleum. It certainly is more pleasant to handle, and it is homogeneous, which petroleum and even petrol now is not. Now, of course, denaturing becomes an important question here, and may possibly be the crux of the whole thing. Pyridine is obviously good from the potability point of view. Benzol—say, 15 per cent. — showed results as to power quite equal to alcohol alone. Benzol requires obviously more air than alcohol for complete combustion, therefore more air can be admitted by obvious mechanical means, and if the measure is maintained at a constant, as it can easily be, and the cylinder jacket temperature be also kept constant—at any given compression—equal efficiencies are obtainable; but the allowable safe compression is less the more benzol present. Dr. Ormandy makes much of the increasing demand for petrol in America, its consequent dearness and scarcity, emphasising the recent history of the so-called cotton famine. Combined action may enhance prices, but France, Germany, Russia, Austria and Hungary can each, with home-produced alcohol as a competitor, resist any attempt to unduly raise prices. The argument is clear. Remove, as far as is possible, all restrictions and hindrances to the use of alcohol for motors and industry generally. Take a liberal view of the field for denaturising agents, then if the supply of petrol in the case of power requirements falls below turn, as these countries, our rivals, do to home-grown produce. The Americans will, of course, supply their own wants first—does it look as if there would be enough for the rest of the world? Sir J. Macdonald, Lord Justice Clerk of the Scotch Supreme Courts, pointedly expressed the opinion that at the rate power was demanded for motors of one or another sort there would not. Mr. Nicholson, in the discussion, more than con-

med his attitude expressed in March after the paper the Society of Chemical Industry, and, besides, hibited an intimate knowledge of motors and their quirements. Doubtless he sees in this development e outlet for over-production of alcohol. The whole iscussion was hopeful, and M. Sigmund Stein, whose fe has been spent in the cultivation of beet roots, ated that it could be grown anywhere, even under onditions in which potatoes would fail, any soil, anyhere. At any rate, it is good to hear that we are ot to this extent dependent on other lands. France rows 2,000,000 tons of beet used annually in the production of alcohol. An expert, Mr. Sennett, nstanced the deplorable failure of the magnificently-quipped artificial silk factory near Coventry, for want f alcohol, in so far as that want was contributory, s a disgrace. He observed that the authority for the hortage of the supply of petrol was no other than Dr. Redwood, the chairman himself. It was to him onvincing that in the course of experiments quoted e three fuels gave the same output of power in an ngine built to get the best results from petrol and ot from alcohol. We cannot help concluding that n important step forward has been taken. The tilisation of alcohol, untaxed and suitably denatured r British industries, has received a valuable impetus y this discussion of the influentially positioned utomobile Club.

Lieutenant-Colonel Holden, Chairman of the utomobile Club, suggested two very important onsiderations as to the alcohol used for motive ower, which it is well to record for experiment nd for information. 1. That the substance sed for denaturing should preferably not be ert, but should add to the energy latent in e fuel. 2. That in any case the denaturing ubstance should pass away with the products f combustion and not be liable to leave any bjectionable residue in the cylinders, valve hambers, or on valves or seatings, passages, c.

It is perhaps desirable to indicate the kind f denaturant employed. Professor Wittelsöfer says, that after using in Vienna for six onths the denaturant described, no injurious fect of any kind was observed. It was 15 per ent. of benzole to 100 litres, with a trifling mount of pyridin base as a "decharactering" agent, and the price was eminently asonable. In Germany the denaturant was ade more distinctive and characteristic by e addition of a dye colour — crystal or ethyl violet—added in the proportion of 1 in 00,000. It is so pure, that only the very mall amount of 1 per cent. of ash residue mains on analysis; this distributed in the roportion above-mentioned, is practically no sidue of moment. The Vienna mixture was investigated by Professor Dafert, by order of the Minister of Finance, and it is said to consist of 5·1 litres of benzine to 100 litres alcohol, 0·5 litres of pyridin or heavy "retone" oil, 0·2 grammes of methyl-violet, costing, according to the Professor, 35 heller. The Chairman of the Conference hoped to exhibit a 1,000 horse-power motor at work in a locomotive next year.

One can reasonably urge that what is done in Germany and France can be done here. Potential whisky may surely be disregarded in selecting a denaturing agent for motor spirit. It should not be left unsaid that engineering questions have very important influence on the economical use of different agents for motive power, if but the concession of alcohol were granted, the needful adoptions of means to end would speedily be effected. As it is, enough is demonstrated to place alcohol in the first rank as a source of motor power.

I propose to conclude this paper after some reference to the use of alcohol for illumination, heating and other domestic purposes, by a few lantern illustrations of locomobiles taken from the voluminous and interesting report of the German congress on the applications of denatured alcohol, held in Berlin in 1902.

French and German enterprises do not stop here. Alcohol has been successfully applied to illumination and to domestic uses. The day of the old tallow candle with its wick cutters and snuffers is inconceivable. The simple oil lamp untended smoked and got sooty, and its improvement was a matter of chimney or air shaft. Gas was added at the beginning of last century to the brilliant illuminants. Then petroleum appeared on the scene and its development with the improvement of its lamps and in consequence of its cheapness a dominant position as an illuminating agent was gained.

There were limitations; smell, too great development of heat and fouling except upon careful conditions. These methods of lighting are based in the creation of a self-illuminating flame. When the Austrian chemist, Auer von Welsbach, invented the incandescent light quite a new departure was made. Flame was deprived of its illumination by the intimate mixture of the vapour and air, complete combination ensuing, but illumination resulting from impact upon incandescent substances which, acquiring heat, became illuminating. The burner so familiar and so useful, known as Bunsen, formed the basis of a suitable apparatus for the mixture and supply of the gases and

air. The Auer principle obviously was most easily applicable to the slightly illuminating, but free from soot spirit flame. The first incandescent spirit lamps were brought out in 1895 and were a success. The enterprise of inventors and manufacturers has resulted in a number of good lamps being introduced which can compete with other forms of light. It is perhaps unnecessary to indicate the principles of construction developed in the forms of lamps. Yet at first the earliest form of suction by wick out of the bowl and a small auxiliary flame for heating and converting into vapour was used. A second form was the abandonment of this, and conducting heat by a flame or by freely burning spirit in a heating pan to the wicks, where the heat gasified the alcohol. A third system was the employment of a reservoir above the burners—not below as in ordinary lamps—so that the liquid for the lamp, required for gasification, is not conducted by suction by hydrostatic pressure. This form has obvious advantages, especially for outside illumination or the lighting of great spaces. Light equal to that of small arc lamps is easily produced. Two hundred and fifty candle-power is equally well obtained, and by the employment of artificial pressure, 1,000 candle-power light has been produced.

A spirit lamp has advantages over petroleum, independent of the possible increase, and cheapness in the amount of light produced, diminution of the heat, and vitiation of the atmosphere. Spirit and petroleum differ from each other in their chemical composition, in that 1 kilogramme at a strength of say 90 per cent. alcohol developes 5,500 heat units, whilst 1 kilogramme of petroleum evolves 10,000 units if completely consumed. This is an obvious advantage in favour of alcohol. Calculation shows that the calorific radiation is favourable to alcohol, since an alcohol lamp of 25 candle-power radiates 288 calories per hour, whilst a petroleum lamp of the same capacity gives 750 calories. Thus the slight heating power of incandescent alcohol lamps is an important advantage. Then as to atmospheric vitiation by carbonic acid, petroleum contains 85 per cent. carbon, whilst in pure alcohol there is 52·2 per cent. and in 90 per cent. alcohol only 44·6 per cent. carbon. Thus while the combination of 100 grammes of alcohol 90 per cent. evolves only 163 grammes carbonic acid, the same amount of petroleum gives 302 grammes of carbonic acid. Looking at this phase from the illumination point of view an alcohol incandescent light of 25 candle-power produce 86 grammes of carbonic acid per hour, whil a petroleum lamp of the same strength evolve 234 grammes of carbonic acid in the same tim

One other advantage may be claimed for th alcohol lamp, the reduction of the necessity fo constant cleaning of the wick and chimney and the removal of the frequent occurrence soot from smoking, and the unpleasant exuda tions from the bowl. A disadvantage at pre sent accruing to ordinary alcohol, but in a probability soon to disappear, is that of n immediately lighting up. This has bee effected, but at present with some loss economy. Now, after all, within limits, th question of cost will be paramount. Obviousl the production of an equal or greater amou of light at equal or less cost will be alwa an important consideration. The illuminatin power of a flame is measured by its uni of light—that unit in Berlin was the Hefn candle — the illuminating power of whic is a little less than that produced by good normal paraffin candle. Now, th flame of a good petroleum table lam shows 24 H. candle-power, and consume 75 grammes of petroleum = ½ litre hourl an alcohol incandescent lamp giving th same light uses only 50 grammes of 90 per cen of alcohol, and the consumption of material ex pressed in cubic centimetres is about 6 to 10 i favour of alcohol. If, therefore, a basis 20 pfennige per litre for petroleum and 25 p per litre for alcohol is assumed, the result is t produce a light of 25 candles; 2 pf. per hou is required for petroleum, and 1·5 pf. for alcoho which is one-quarter cheaper compared wit petroleum lighting. It will be seen tha alcohol can compete abroad with petroleum In spirit lamps manufactured in the sizes mos required, with illuminating power of 20-70 H candles, so that they satisfy all industria and household demands, the consumption spirit for a power of 10 H. candles varies fro 15-30 c.m. per hour, so that at the usu current retail price of 25 pf. per litre of spiri the production of 10 candle-power lies betwee 0·37 pf. and 0·60 pf. In the above-mentione powerful light burners, the consumption fo 10 candle-power diminishes as far as 12 c.m so that the cost of material for 10 candle-powe amounts to 30 pf. From these data it can b seen that the alcohol incandescent light called on to compete with petroleum, and t take its place side by side with other kinds illumination. With cheap, suitably denature alcohol, this can be done.

I am indebted to Mr. Hugo Lorenz for lamps now alight. To Mr. J. Flack for lamps and apparatus for domestic use, for a heating stove and lamps. Mr. Massey shows two lamps which come direct from Berlin. The burners are on the "Amor" principle like Mr. Lorenz's which has been in domestic use a long time.

One may note with advantage that the increase in denatured spirit in Germany is for 1902-03 2½ million gallons 100 per cent. alcohol over the quantity for 1901-02. Apparatus of the value of £5,300 have been sold in 1902-03—not including motors—against £3,800 in 1901-02.

The quantities of appliances sold by the "Centrale" are surprising.

	1902-03.	1901-02.
Hand cookers	94,300 ..	73,000
Cheap simple health cookers ..	11,650 ..	9,300
Two or three flame cookers ..	8,900 ..	8,000
Irons for ironing stoves ..	3,000 ..	600
Burners and pendant lamps ..	37,500 ..	21,850

Now, what can be done to effect this? Of course, first comes State aid in the way of reasonable concessions as to spirit and duty; reduction of revenue from existing sources need scarcely be feared. New industries will arise, employment will follow, luxuries will be desired beyond mere necessaries, profit will accrue where labour of various kinds is employed, and so revenue will accrue from sources now untapped. Among the benefits surely may be the promotion of the greatest industry for any land, and appreciated almost everywhere, but in the United Kingdom, namely that of agriculture. Potatoes and Ireland are indissolubly connected, and the agricultural statistics of the land show possibilities which need only enterprise and State aid to make great. The only report to which I have yet gained access is the third annual report of the Department of Agriculture and Technical Instruction for Ireland. Among the very varied subjects therein treated, the only report I find is one on early potato growing. I cannot quote it usefully, except to note that the report hopes for great and increasing success. It warns agriculturists that attention and selection are the only roads to success, and significantly indicates that the cost and mode of transport must be fully arranged, and so on. Our rivals saw this long ago, and provided accordingly as I have already said. It was lamentable that so great a lover in the best sense, of his country, the Hon. R. Plunkett, should have been cut off from the active pursuit of a beneficent campaign of industrial recuscitation by the chances of an election. He, perhaps more than anyone, knows the truth as to Irish industries, and one day may benefit us all. Nevertheless, I may record briefly what has been done in Germany as regards the potato. I quote from a catalogue issued in connection with the Potato Exhibition in 1903, and from a contributed article by Dr. Behrend of which I give an abstract.

The cultivation of the potato in Europe is of quite recent date, especially when compared with grain, which has been cultivated thousands of years. Gradually the extraordinary value of the potato as a nutritive food became known and its cultivation increased accordingly. The extent to which the cultivation of the potato was carried on in Prussia during the second half of the 18th century was due to the efforts of Frederick the Great. He appreciated thoroughly the great politico-economical significance of the cultivation of the potato, although he could not foresee how enormously this would be extended in years to come. As time progressed circumstances proved that the great king was right. In a comparatively short time, the cultivation of the potato developed into one of the most important branches of agriculture in the country. In importance it can not only compete with all other varieties of bread-fruit, but it even exceeds them. From 26¼ million hectares (2,280·3 sq. yards) or 12·5 per cent. were planted with potatoes during the year 1901. Compared with all other civilised countries, Germany contains the most extensive potato lands, in proportion to its area, and the number of inhabitants.

The following figures show the amount cultivated during the year 1900:—

	On a Total Area of 100 hectares.	To 10,000 inhabitants.
Germany	2·9	64·3
Austria	3·9	44·8
Hungary	1·8	30·6
France	2·9	39·4
Great Britain and Ireland	1·6	12·4
Russia	6·7	33·0
United States of America	0·1	13·8

The potato crops have increased enormously for several years, not only as to the quantity produced on a certain space but the total amount.

	Tract cultivated, Hectares.	Total crop mill, double cwt. (100 kilos)	Crop per Hectare, double cwts. (100 kilos)
1896....	3052·790	323·29	105·9
1897....	3067·762	337·76	110·1
1898....	3010·598	367·21	119·2
1899....	3131·463	384·86	122·9
1900....	3218·777	405·85	126·1
1901....	3318·832	486·87	146·7

It is impossible to prophesy with any degree of certainty how large the potato crops will become in the future, but it seems quite certain that calculation on greatly increased crops in years to come may be made not only as regards the total amount but also the amount to a given area.

These prospects can only prove a cause of great rejoicing; they advance the interests of our national agriculture and our entire political economy. Men of science have investigated the conditions under which potatoes thrive, and by determining the principles on which the cultivation of flourishing sorts of potatoes depend, have laid the foundation for this increase in crops. Potatoes require good soil for the planting. Experience has proved that wherever the cultivation of potatoes has been exclusively carried on grain crops have inereased, notwithstanding the large crops occupied by the potatoes.

The most important way of utilising potatoes are:—(1) Food; (2) animal fodder; (3) employment in technical work—(*a*) Distillation; (*b*) manufacture of starch and starch products (starch sugar, starch syrup, dextrine, &c.); (4) Export; (5) seed. Potatoes not used for one of the purposes mentioned, decay.

Potatoes as Fodder.

Potatoes are an excellent fodder, and potatoes play an important part in farm feeding. The limit for use as human food is quite sharply drawn; such is not the case with fodder, since potatoes can be advantageously used in almost unlimited quantities, becoming thereby an important factor in political economy. Fodder grown on German farms is rarely sufficient. To this end the growth of potatoes for fodder should be encouraged, so rendering foreign feeding stuffs superfluous.

The inconveniences from the necessity for fresh potato as fodder, and the cost of transport can be remedied by removing the greater part of the water contained in potatoes. By drying they are rendered more durable. It is easy to convey them, they can be utilised in other ways. It has always been technically possible to dry potatoes; the problem however, was whether the drying process was too costly. A short time ago this agricultural problem was successfully solved. The Association of Manufacturers of Spirit are to be credited with this success.

A prize was offered for the best apparatus for converting potatoes into stable fodder at a moderate price. Recognising the importance of this problem, a number of municipal authorities and agricultural associations, the Department of Agriculture, the Imperial Department of the Interior, the German Agricultural Association, the Association of Manufacturers for Utilising Spirit, the German Association of Manufacturers of Spirit, and a number of Chambers of Agriculture financially supported the prize fund.

The processes which were awarded prizes are all based on direct fire for drying potatoes cut in chips or in layers, and have fully satisfied the conditions laid down for competition. Dried potatoes can be used also as a raw product for technical trades. We shall now be in a position to use the surplus potatoes to advantage.

The surplus of former times forced the starch manufacturers and distillers into enormous production, reducing prices to vanishing point. In future potatoes which cannot be used advantageously and quickly will be sent to the drying establishments, which will be erected in parts of the country where potatoes are extensively cultivated. Here they will be transformed into a cheap wholesome fodder for use on farms, light traction by potato-produced alcohol being employed. Drying potatoes for fodder will become a new agricutural business capable of competing with starch manufacture and distillation in utilising surplus production, and with advantage to the agrarian policy of the nation.

For many years starch manufacture has been popular method of utilising potatoes. Starch material is here used either for manufacturing pure starch or for conversion into alcohol by well-known means.

The by-products of some technical applications of potatoes furnish large quantities of nutritious fodder, and consequent manure.

Distilleries.

Distillation is the most important of the two industries cited. The manufacture of spirits is

the only form of utilising potatoes, concerning which reliable statistics exist. During the years 1896-97—1900-1, an average of 24·5 million cwts., about 7 per cent. of the total crop, was used for spirit. Many distilleries are situated in the eastern part of Germany, principally in the Prussian provinces, Posen, West Prussia, Pomerania, and Brandenburg, all of which are centres of the distilling industry. In distilleries the following amount of potatoes were used :—

	Mill. cwts.	Crop amounting to.	Per cent.
In Posen	4·89	28·65	17
West Prussia ..	2·34	20·78	11½
Pomerania	4·04	27·03	15
Brandenburg ..	5·47	44·25	12½

In these eastern regions the price of spirits regulates the price of potatoes. Taking into consideration all branches of industry requiring potatoes, 50 per cent. of the total crops are utilised in this manner. Thousands of farms owe their existence to these distilleries. About 6,000 agricultural potato distilleries are in operation in the German Empire, 4,000 of which represent the chief activity of the respective farms, whereas the remaining 2,000 play a secondary part. The production of spirit from other substances such as grain, fruits, molasses (remnants of sugar), is insignificant in comparison to that of potatoes. During the year 1896-97, 350 million litres of pure alcohol were produced in distilleries of all kinds, and 290 million litres were produced in agricultural potato distilleries alone. Calculating the hectolitre at 40 marks this represents a value of about 116 million marks, or £5,800,000.

The proportions between the various purposes for which spirit is employed has in the course of time varied greatly. In 1888-9, 280 millions litres were used: 217 millions for potable liquors, and 63 millions for other purposes, a proportion of 100 to 29. In 1901-02 the proportions were 100 to 55, 238 million litres being used for spirituous liquors and 130 million litres for export and technical purposes. This increase is due to the use of more spirit for technical purposes, whereas the exportation of former years has diminished.

With control of such an industry, naturally means for increased consumption are sought for, and these must obviously be industrial. A large part of the spirit produced is used in chemical industries. In 1901-2, of the 116 million litres calculated as alcohol used for other purposes than spirituous liquors, about 21 million litres were used in chemical industry. This branch of industry is so comparatively young that it is impossible to estimate the increase, but everything points to a large increase of demand in the future.

One of the uses well known in Great Britain is the employment of fermentation in manufacturing vinegar.

About 19 million litres of spirit are used annually for manufacturing vinegar. The importance of this industry must not be undervalued, but regard must be had to the substitution of wood vinegar or acetic acid especially for technical purposes. Even in England vinegar is largely displaced by acetic acid from wood—of course highly purified—but nevertheless acetic acid which has never the softness of fermented vinegar.

In my opinion, it is therefore very desirable for every reason to restore fermented vinegar either direct or from alcohol to favour. The spirit industry and also the agricultural interests with potatoes or cereals would thus be benefited.

The central office for utilising spirit in Germany has encouraged the use for manufacturing vinegar by granting manufacturers extra discounts.

The annual use of spirits for the production of power, light, and heat since 1877 has increased from 13·8 million to 77·8 million litres, *i.e.*, six times the amount.

The use of spirit for heating and cooking purposes in Germany plays an important part, perhaps as far as the quantity of spirit used is concerned the most important part to-day. The small cooking apparatuses in a large number of households, use by far the largest part of the spirit devoted to the production of heat, whereas the large hearth cooking apparatuses have not been so generally adapted as perhaps they deserve. It may be imagined what capabilities of development this mode of employing spirit still offers. A great future awaits the employment of spirit for ironing purposes, for the spirit iron may be regarded as a perfect apparatus of its kind; the time may come when it will have ousted all other methods of ironing, and even if a single iron regarded as a consumer of spirit is of little importance, yet the amount of spirit which may be consumed when the spirit smoothing iron is in universal use, must not be under-rated.

I am indebted to Mr. J. Flack for the appliances on the table.

I have ventured to consult Mr. Sigmund Stein's (Liverpool) works on beet and sugar growing in England, Scotland and Ireland, 1898,

TABLE VIII.—ANALYSIS OF SUGAR BEETROOT.

England.

The Trials were made by	Farming at	What kind of Soil.	What Manure was used and How much per Acre.	Yield of Roots per Acre in Tons.	Length of time of Vegetation.
					Days.
The Right Hon. The Earl of Denbigh	The Newnham Home Farm, Warwick	Sandy loam, sandy subsoil......	$6\frac{1}{2}$ cwt. Proctor and Ryland's manure, 1 cwt. nitrate of soda	16·75	153
" " ..	Pailton Field Farm, Rugby, Warwickshire	Stiff loam, clay subsoil	15 tons farmyard manure, 3 cwt. superphosphate, $1\frac{1}{4}$ cwt. sulphate of ammonia	10·75	186
" " ..	High Cross Farm, High Cross, Rugby, Warwickshire	Heavy loam, clay subsoil	12 loads farmyard manure, 3 cwt. superphosphate, 1 cwt. kainit	13.	180
" " ..	Kirby Manor, Monk's Kirby, Warwickshire	Heavy loam, yellow clay subsoil..	10 loads farmyard manure, 6 cwt. Proctor and Ryland's mangold manure	12·	174
" " ..	Brockhurst Farm, Lutterworth, Warwick	Sandy loam, gravel subsoil......	12 loads farmyard manure, 3 cwt. superphosphate, 1 cwt. Peruvian guano	13·	123
The Right Hon. The Earl of Lathom	Crams Farm, Ormskirk, Lancashire	Light sandy subsoil............	29 tons farmyard manure, 5 cwt. Proctor and Ryland's manure	19·	141
The Corporation of Liverpool..	West Derby Sewage Farm, Fazakerley, Lancashire	Light sandy loam, subsoil sandy	Sewage only	14·85	186
W. F. Lawrence, Esq., M.P.	Cowsfield Farm, Wiltshire ..	Medium loam, subsoil chalk and clay	Farmyard manure, also 2 cwt. phosphate and 2 cwt. bones.	10·50	175
Thomas Golding, Esq..........	Tree Farm, Plantol, Seven-oaks, Kent	Stone shattery, medium loam, subsoil Kentish ragstone	Farmyard manure, with artificial dressing	10·	155
Hon. F. C. Wynn, per Professor Thomas Winter	Glynllivon Home Farm, Carnarvon, N. Wales	Light fibrous loam, subsoil gravel	None	11·25	172
" " ..	" "	" " ..	3 cwt. superphosphate, and 1 cwt. sulphate of potash	10·90	172
" " ..	" " ..	" " ..	6 cwt. superphosphate and 2 cwt. sulphate of potash	11·20	172
" " ..	" " ..	" " ..	6 cwt. superphosphate 2 cwt. sulphate of potash, 1 cwt. nitrate of soda	13·85	172
R. H. Greaves, Esq., per Professor Thomas Winter	Wern, Portmadock, North Wales	Stony loam, subsoil shaly	None	..	164
" " ..	" " ..	" " ..	3 cwt. superphosphate, and 1 cwt. sulphate of potash	12·25	164
" " ..	" " ..	" " ..	6 cwt. superphosphate, and 2 cwt. sulphate of potash	8·80	164
" " ..	" " ..	" " ..	6 cwt. superphosphate, 2 cwt. sulphate of potash, 1 cwt. nitrate of soda	11·10	164

from which I quote his remarks on the analyses.:—

The analyses afford ample proof that sugar beets can be grown in this country quite as well as, if not better than in the regular beet sugar producing countries. The cultivation of the beets analysed was effected under very varying conditions as regards soils, manure, previous crop, and different time of vegetation, in all parts of England, Scotland, and Ireland. My analyses, made according to the latest methods, were directed to ascertaining, among other things, the possible presence of invert sugar. This was found, only in trace, in a few specimens. On an average the roots were well shaped and rich in juice. Some, but only a very small percentage, were woody. Considering the exceptionaly dry season experienced this season in these islands, it is evident from the analyses that we have produced very much superior and better beet roots than the Continent of Europe. The experiments were made with great care, according to my directions, from seed (German, French, and Russian of different origins), supplied by me gratuitously, and carriage paid to the farmers, in parcels from 1 lb. to 60 lbs. I have also supplied every farmer and experimenter with a copy of the analysis of his roots. The continuation of my experiments and analyses will be published in subsequent numbers of this journal.

I shall also send a full record of my analyses to the Government Board of Agriculture, and to the Central Chamber of Agriculture, who take cognisance of these experiments.

I regret that a great many farmers have sent me roots without any remarks or description. In certain cases the name of the sender could not be ascertained. The analyses were made, but the results cannot be published, as I cannot tabulate them without the necessary particulars.

To my satisfaction, I am able to state that great interest has been taken in these experiments, and I have to thank all those gentlemen as well as the press who have willingly helped me in my endeavours.

I would draw special attention to the experiments on the different sewage farms in England, and also to the comparison with Mr. F. O. Licht's analyses of roots grown near Magdeburg, and analysed by him on the same dates as my analyses were made in England.

Beet growing experiments have been carried out before in this country, but never on such an extensive and elaborate scale as this year. I have spared neither trouble, hard work, nor expense, and have done everything in my power to make the experiments a success. The farmers have been instructed by means of pamphlets, leaflets, and continuous correspondence in regard to cultivation, manuring, &c., and I have finally, and for the first time, succeeded in causing a great interest to be taken in beet growing. As the matter now stands, it is only necessary that energetic steps should be taken to establish a beet sugar factory. I am quite sure that as soon as one factory is established, others will follow, and very soon these islands will be independent of foreign countries for the supply of sugar. As I have already stated in several pamphlets, 400 factories will be required to manufacture all the sugar we need. Each factory would cost about £50,000, so that £20,000,000 would be invested at home. By direct and indirect employment work would thus be found for 400,000 men, representing 300,000 families, or 3·2 per cent. of the entire population. If these men were employed for only six months, at 15s. per week, £7,500,000 per annum would be paid in wages.

Facts speak best. I have nothing to add excepting to say that these extensive experiments have proved, even to the most sceptical mind:—

1. That our climate is suitable for beet growing.

2. That we can produce better beets than on the Continent of Europe.

3. That on account of the richness of the beets, it will pay to produce our own sugar in our own country.

4. That by doing this we shall help our farmers, create a good investment, and find permanent employment for 3·2 per cent. of our population.

5. That we shall be independent of foreign countries.

6. That we shall develop and support a great many of our home industries.

REPORT ON THE SUGAR BEET GROWING EXPERIMENTS, 1903. BY SIGMUND STEIN, LIVERPOOL.

In publishing this the ninth report of my sugar beet growing experiments in the United Kingdom, for the year 1903, I may say that I have achieved results which surpass in every way my previous experiments.

My farmer friends did their best to grow roots, and the results which I now publish show that they can compete successfully with their continental *confrères*.

In general the roots were well-shaped, and showed satisfactory saccharine contents and weight.

I may say that I have grown sugar beetroots in almost every part, every county in England, Scotland and Ireland, and have established a practical knowledge about beet growing throughout the United Kingdom. It was rather a difficult task to undertake, but with persistent work, close attention to the serious matter I have in view, brought a success of which British agriculture can well be proud. I have stated over and over again that the question of establishing a British beet sugar industry is a national one, and one of national importance.

I am sure that the time is not far off when we shall see beet sugar factories working in these islands, and that we shall show our independence by producing all the sugar required for home consumption.

Such great interest is manifested in my experiments as I am inundated with letters from all parts of the country, showing the interest taken in this important question. I have been asked by leading men in the country to continue my experiments next season, and in spite of the heavy work which these experiments

involve I cannot do otherwise than follow the suggestions laid before me.

As in former years different kinds of seeds have been used, and I would draw special attention to the disinfected kind of Aderstedt, which show exceptionally good results.

This year a greater variety of seeds have been used than in previous years, on account of my desire to study the results obtained from their use in different counties and under different conditions. Soil and manure varied also this year.

I regret to find that I have by me, as in past years, many parcels of roots which reached me without the necessary data to enable me to forward my results of analysis to the experimenters. Should the senders furnish me with such particulars as would lead to the identification of the parcels they forwarded, I could after receipt of such particulars forward them my report.

There have been this year fifty-two experiments—*i.e.*, thirty-five in England, fifteen in Scotland, and two in Ireland.

As in previous years, I have compared my analysis with those of Mr. F. O. Licht, Madgeburg, and I give below the comparative results:—

Comparative Results.

	British Grown Roots. 1903.		German Grown Roots. 1903.
Average weight of roots, without leaves, in grammes	993	..	560
Quantity of sugar in 100 parts of the juice	17·28	..	17·87
Quantity of non-sugar in 100 parts of the juice	2·65	..	3·83
Quotient of purity	86·98	..	85·63

Regarding the quantity of juice and pulp, the average in 1903 was as follows:—

	British.
Juice	92·88
Pulp	7·12
	100·00

I would invite the reader, as figures speak best for themselves, to compare the above and make his own conclusions.

I have conclusively proved that our climate, our soil, and our conditions are quite suitable for sugar beet growing, and that we can produce better roots than our continental competitors.

The country may now be considered ripe for the establishing of a gigantic industry, as our farmers are educated, labour is plentiful, and the capital would be forthcoming.

With regard to the tonnage per acre, British grown roots in my experiments have yielded as:—

	Tons.		Tons.
1897	16·07	1901	19·04
1898	16·03	1902	15·90
1899	16·09	1903	14·50
1900	19·01		

The tonnage this year is smaller than previous years; but, as is well-known, the season was very unfavourable. In spite of all, such a tonnage leaves little to be desired, as it is very satisfactory.

I will not repeat the figures already given in the various publicatious laid before the public, but would simply add that the sympathisers with my scheme increase year by year, and many letters are to hand asking for a copy of this year's report. This shows clearly that the scheme is becoming a subject of interest not only to agriculturists, but to manufacturers and capitalists as well.

The Brussels Convention of March, 1902, has removed many obstacles to the starting of this industry in the United Kingdom, and I cannot do better than refer to the discussion on the sugar question in our Parliament, in which it was clearly stated and proved that with the fall of the bounties the introduction of the sugar beet industry would be secured.

Newnham Paddox Estate, County of Warwick.

Sugar Beet Cultivation in the Year 1903.

This is the fifth year that sugar beet has been grown on the estate of the Earl of Denbigh at Newnham Paddox, in the county of Warwick, and it is most encouraging to find that, though the weight of the roots grown per acre is somewhat less than in some previous years, yet that quality is very good, and better than the roots grown in Germany.

In addition to the plot grown on the Home Farm, sugar beet was also cultivated by four of the tenants on the estate, namely, Mr. James L. Harrison, of Pailton Fields; Mr. William Kenney, of Brockhurst; Mr. J Parker Toone, of High Cross; and Mr. John Wright, of Kirby Manor.

Lord Denbigh has always arranged that the sugar beet should be grown under the same conditions as mangels, and for the weight of the mangels to be taken at the same time as the sugar beet.

Mr. John Harrison, of Pailton, was good enough to undertake duty of weighing the roots, and he selected the plots on the 21st of October, and the roots were weighed on the same day.

The average weight of the sugar beet roots cleaned, and with the tops removed, was 13 tons 3 cwt. 2 qrs. 18 lbs. per acre. The best crop was 16 tons 15 cwt., and the lightest 10 tons 17 cwt.

The mangels cleaned, and without the tops, averaged 32 tons 11 cwt. 1 qr. 20 lbs., and the best crop 44 tons 4 cwt. and the lowest weight was over 27 tons an acre.

There is no doubt that the season was not a

TABLE IX.

Previous Crop.	F. O. Licht, Magdeburg. Average weight in grammes.	Sugar in 100 parts of juice.	Non-Sugar in 100 parts of juice.	Purity.	Aderstedt. Average weight in grammes.	Sugar in 100 parts of juice.	Non-Sugar in 100 parts of juice.	Purity.	Sugar in 100 parts of roots.	Wohanka. Average weight in grammes.	Sugar in 100 parts of juice.	Non-Sugar in 100 parts of juice.	Purity.	Sugar in 100 parts of roots.	Breustedt. Average weight in grammes.	Sugar in 100 parts of juice.	Non-Sugar in 100 parts of juice.	Purity.	Sugar in 100 parts of roots.
Oats	560	16·87	2·83	85·63	811	16·20	2·30	87·56	15·60	...	...	...	...	...	...	...	...	...	...
,, ...	560	16·87	2·83	85·63	...	..	...	...	...	...	...	...	...	...	516	16·70	2·70	86·08	16·00
,, ...	560	16·87	2·83	85·63	888	16·30	2·30	87·63	15·40	...	...	...	...	...	...	...	...	...	...
Tares	560	16·87	2·83	85·63	...	...	...	...	...	823	19·70	2·90	87·17	19·00	...	...	...	...	...
Oats	560	16·87	2·83	85·63	...	...	...	...	...	...	...	...	...	...	619	18·30	2·70	87·14	17·40
,, ...	560	16·87	2·83	85·63	...	...	...	...	...	899	17·50	2·90	85·78	16·80	...	...	...	...	...
Grass	560	16·87	2 83	85·63	...	...	...	...	...	849	19·90	2·60	87·96	18·20	...	...	...	...	...
										Vilmorin Blanche.					Vilmorin.				
Oats	560	16·87	2 83	85·63	834	17·30	3·10	84·80	16·80	...	...	...	...	...	...	...	...	...	...
,, ...	560	16·87	2 83	85 63	...	...	...	...	...	489	17·30	2·40	87·81	16·40	...	...	...	...	...
,, ...	560	16 87	2·83	85·63	901	17 60	2·70	86·69	17·10	...	...	...	...	...	...	...	...	...	...
,, ...	560	16·87	2·83	85·63	777	15·10	2·80	84·38	14·50	...	...	...	...	...	...	...	...	...	...
,, ...	560	16·87	2·83	85·63	1011	18·40	3·20	85·19	17·10	...	...	...	...	...	...	...	...	...	...
Barley	560	16·87	2·83	85·63	399	16·70	2·70	86·08	16·00	...	...	...	...	...	...	...	...	...	...
Oats	560	16·87	2·83	85·63	...	...	...	...	...	...	...	...	...	...	942	16·40	2 30	87·70	15·90
,, ...	560	16·87	2·83	85·63	...	...	...	...	...	...	...	...	...	...	1015	17·10	2·30	8 ·14	16·40
Average of the 15 Experiments in Scotland					778	17·30	2·66	86·70	16 57	...	...	...	...	...	...	...	...	...	...
					Breustedt.														
Spring Oats	560	16·87	2·83	85·63	1117	16·90	2·40	87·56	16·20	...	...	...	...	...	...	...	...	...	...
Turnips...	560	16·87	2·83	85·63	867	17·30	2·30	88·20	16·60	...	...	...	...	...	...	...	...	...	...
Average of the 2 Experiments in Ireland					...	...	...	...	..	992	17·10	2 35	87 88	16·40	...	...	...	...	...
Average of the 52 Experiments in the United Kingdom in the Year 1903										933	17·28	2·65	86·98	16·89	...	...	...	...	...
Compared with German grown roots according to Mr. Licht, Magdeburg, in 1903										560	16·87	2·83	85·63	...	...	...	...	...	...

favourable one for the sugar beet, and the weights per acre are much less than in previous years.

We have now to consider the analysis of the roots as regards their value for the manufacture of sugar, and Mr. Sigmund Stein, of Liverpool—so well known to all for the time and attention he gives to the sugar beet question—has analysed the roots, and his report is most encouraging.

The seed sown was in all cases the Klein Wanzleben, and Mr. Stein reports that the roots are all most satisfactory, both in saccharine contents and weight, and superior to roots grown in Germany and in every way excellent for manufacturing sugar.

In the following Table we only give the results of the analysis of the sugar in the juice and in the roots, and the quotient of purity, as it is from these that the value of the roots for manufacturing purposes are calculated:—

Roots Grown at Newnham Paddox.

	Highest.	Lowest.	Average.	German Roots.
Quantity of sugar in 100 parts of the juice	19·30	16·80	18·34	16·87
Quantity of sugar in 100 parts of the roots	18·40	16·00	17·44	not given
Quotient of purity	89·10	87·61	88·49	85·63

The above figures speak for themselves, but it will be worth considering what amount of money could have been realised if roots of the standard grown at Newnham could have been sold to a sugar factory, and from the data of Dr. Carl Stammer we find that the heaviest crop of sugar beet would have been worth £22 16s. 6d. an acre, and the crop with the lowest weight £14 14s. 6d., and the average value per acre is £16 17s. 6d.

There are, of course, many things to be considered, and a most serious one would be the cost of hauling the roots to the sugar factory. Though in America they think very lightly of 50, or 100 miles, in England we must have a factory within a short distance, and assuming we allow £1 17s. 6d. for the cost of delivery, and the extra cost of cultivation, this will leave £15 an acre, and this must be compared with the value of a crop of mangels for consumption by cattle.

Taking the average of the crop of mangels grown at Newnham as given above, at 32 tons 11 cwt. an acre, what are these worth for consumption on the ground. I have sometimes discussed this with experienced tenant-right valuers, and I have been told that, at times, the value is 10s. or 12s. or even as high as 15s. a ton, but judging from my own experience, if the value was put at 7s. 6d. a ton I think this would be more than usually made.

The best crop of mangels came to 44 tons an acre, and if the grower was told these were worth £22 an acre, he would ask how it was to be made, and even at 7s. 6d. there might be some difficulty in proving that his cattle had made a profit of £16 10s. an acre.

But the average crop must be taken, and the 32 tons 11 cwt. at 7s. 6d. per ton would be £12 4s. an acre, and if the grower could realise this amount I am sure he would be very well satisfied.

If these calculations are at all right it shows that, grown under exactly the same conditions, it may reasonably be contended that a crop of sugar beet will make £15, as against £12 4s. made by mangels, after making full allowance for the extra cost of cultivation and raising of the sugar beet.

I will only add that the experiments carried on by Lord Denbigh, at Newnham Paddox, were commenced to see if sugar beet could be grown in England of as good quality as in Germany, and during the five years these trials have been made it has always been proved that we can grow roots that show a better analysis than the German ones, and what is now wanted is some capitalist who will start a sugar factory with the best and latest improvements; and I am pleased to hear that arrangements have been made to obtain a large tract of land in Ireland for the growth of sugar beet, and that in a short time we shall hear of sugar being made in that favoured country.

Many people have in the past doubted the possibility of growing good sugar beet in the British Isles in years when there was not much sunshine. It is interesting therefore to note that in 1902 and 1903, which have been nothing like so hot as the three or four preceding years, there have been no material differences in the analysis of the sugar beet grown at Newnham Paddox.

Henry H. Cave.

Estate Office, Rugby.

It may be well to give the latest accessible figures.

Spirit Duty.

The net receipt of duty under this head in the year 1902-03 amounted to £19,033,296, allocated as follows:—

To the Exchequer	£18,164,359
,, Local Taxation Accounts	868,937
	£19,033,296

An increase of £542,517 compared with the net receipt of the preceding year divided as follows:—

Exchequer	£516,938
Local Taxation Accounts ..	25,579
	£542,517

Comparing the number of proof gallons of spirits distilled in 1902-03 with the number distilled in 1892-93 there was an increase of 5,330,000 gallons or 12 per cent. The number of distilleries at work throughout the kingdom in the year ended 30th September, 1892, was 168. In the year ended 30th September, 1902, the number was 190, nine of which were in England, 152 in Scotland, and 29 in Ireland, an increase of 32 in the period.

The number of proof gallons of spirits remaining in bonded warehouses on the 31st March, 1893, was 99,756,000, and on the 31st March, 1903, 166,527,000, an increase of 66,771,000, or 66 per cent. The

number of proof gallons of spirits on which duty was paid was 31,393,000 in 1862-93, and 35,897,000 in 1902-03, an increase of 4,504,000 gallons, or 14 per cent. The number of proof gallons retained for consumption as beverage in the United Kingdom was, in 1892-93, 30,661,000, and in 1902-03, 34,765,000, an increase of 4,104,000 gallons, or 13 per cent. If to these figures the numbers of gallons of Colonial and foreign spirits imported be added, the consumption per head of the population in 1892-93 was 1·00 proof gallons, and in 1902-03, 1·03 proof gallons.

The number of proof gallons of home-made spirits exported in 1892-93 was 3,873,000, and in 1902-03, 6,439,000, an increase of 2,566,000, or 66 per cent.

The total number of proof gallons of home-made and Colonial and foreign spirits methylated in 1892-93 was 3,535,000 gallons, and in 1902-03, 5,452,000, an increase of 1,917,000 gallons, or 54 per cent.

The rates of duty in force between 1892-93 and 1902-03 were as follows:—

From 1st April, 1892, to 16th April, 1904, 10s. 6d. per gallon "computed at proof."

From 17th April, 1894, to 30th June, 1895, 11s. per gallon computed at proof.

From 1st July, 1895, to 5th March, 1900, 10s. 6d. per gallon computed at proof.

From 6th March, 1900, to 31st March, 1903, 11s. per gallon computed at proof.

Inclusive in each case of 6d. per gallon, which, under the provisions of 53 and 54 Vic., c. 8, section 7, is required to be surrendered to the Local Taxation Accounts.

By the Finance Act, 1902, power was given to our Board, subject to certain conditions, to authorise the use of spirit free of duty in arts and manufactures.

Immediately upon the passing of the Act we took this provision into consideration, and we drew up the following minute for the information and guidance of persons desiring to avail themselves of the concession made by it:—

"THE FINANCE ACT, 1902.

"The Board take into consideration Section 8 of the Finance Act, 1902, which runs as follows:—

"(1) Where, in the case of any art or manufacture carried on by any person in which the use of spirits is required, it shall be proved to the satisfaction of the Commissioners of Inland Revenue that the use of methylated spirits is unsuitable or detrimental, they may, if they think fit, authorise that person to receive spirits without payment of duty for use in the art or manufacture upon giving security to their satisfaction that he will use the spirits in the art or manufacture, and for no other purpose, and the spirits so used shall be exempt from duty:

"Provided that foreign spirits may not be so received or used until the difference between the duty of customs chargeable thereon and the duty of excise chargeable on British spirits has been paid.

"(2) The authority shall only be granted subject to a compliance with such regulations as the Commissioners may require the applicant to observe for the security of the revenue, and upon condition that he will, to the satisfaction of the Commissioners if so required by them, render the spirits unpotable before and during use, and will from time to time pay any expenses that may be incurred in placing an officer in charge of his premises.

"(3) If any person so authorised shall not comply with any regulation which he is required to observe, he shall, in addition to any other fine or liability, incur a fine of fifty pounds.

"It is, in the first place, to be observed that the privilege of using spirit duty-free, as contemplated by the section, is to be a personal privilege, entailing personal obligations on the person or persons to whom it is granted; and it follows from this that there can be no question of the Board's granting any general authority under the section to classes of persons, but that each person or body of persons who desires to obtain the benefit of the section must make separate application to the Board, who will consider all the circumstances of each separate application, and form their judgement upon them.

"At the same time, in laying down some general principles by which they will be governed in dealing with applications submitted to them, it may be possible for the Board to indicate certain classes of cases to which the benefit of the section could not, under any circumstances, be conceded, and so to prevent the multiplication of applications which cannot possibly be entertained favourably.

"With this view, and also for the purpose of affording guidance generally to the public and to their own officers with respect to their policy in administering the law, as laid down in the section, the Board proceed to embody in this Minute the following observations on the subject.

"The section requires that before the Commissioners can authorise the use of spirits in any 'art or manufacture'—terms which they interpret as including the application of spirit to scientific purposes—two main conditions must be fulfilled, viz.:—

"(*a*) It must be proved, to the satisfaction of the Commissioners, that the use of methylated spirits is unsuitable or detrimental for the particular purpose; and

"(*b*) The security of the revenue must be guaranteed by such means as the Commissioners may require.

"These conditions are cumulative, not alternative—unless both can be fulfilled there can be no question of a grant of the authority contemplated by the section. In every case therefore it will be necessary to scrutinise in the first instance the objections that may be alleged to the use of methylated spirits, and it is only after the validity of such objections has been admitted that it will be necessary to proceed to consider whether, or by what means, the security of the revenue can be guaranteed.

"It was explicitly stated in the House of Commons,

both by those who promoted legislation in the sense of the section, and by the Chancellor of the Exchequer who assented to it on behalf of H.M. Government, that it was to be understood that the Commissioners should exercise the discretion conferred upon them with great caution, and with a very strict regard to the security of the revenue; and the Board themselves feel strongly that no other attitude would be possible for them.

"They intend, therefore, to insist on a strict observance of the prescribed conditions in every case in which they may grant an authority under the section, and they will not hesitate to reject any application in respect of which it appears to them that the conditions are not, or cannot be, adequately complied with.

"Further, as the duty on spirits is so heavy and of so much importance to the revenue, they consider that they may properly require that the advantage to be obtained by the use of duty-free spirit should be substantial, both in character and in weight, and that the benefit of the seetion should not be accorded in cases of trivial importance or in the purely personal interest of individuals.

"In accordance with these principles, the Board will refuse to entertain applications under the section, as follows:—

"*In respect of Condition (a).*

"Where in an art or manufacture the use of methylated spirit is attended by only slight and immaterial disadvantage.

"*In respect of Condition (b).*

"Where the security of the revenue cannot be guaranteed with reasonable certainty, and at reasonable cost of convenience to the department. (The cost in money will be a matter always affecting the applicant).

"It is manifest that there must be many cases in which the protection of the revenue would be impossible, if the use of duty-free spirit were permitted, and of these there may be mentioned the following:—

"(i) The manufacture of articles intended for human consumption such as medicines, essences and tinctures.

"(ii) The manufacture of articles not intended for human consumption, but capable of being so used, if made with pure spirit or with spirit only temporarily rendered unpotable, such as perfumes or spirituous mixtures for purposes of illumination or of generation of heat or motive power.

"As regards cases to which the benefit of the section may be extended, the Board may say generally that they will be disposed to entertain favourable applications:—

"(1) From recognised bodies formed for the advancement of science, or of scientific education, and requiring to use pure spirit in processes of research or of illustration. Applications of this kind from isolated individuals will not commonly be entertained; but might be so on the recommendation and guarantee of a recognised scientific body.

"(2) From persons engaged in an industrial enterprise of such magnitude and importance as to give to it a character of public interest in its bearing upon national trade. In any such case the concession will commonly be made subject to an obligation to render the spirit unpotable before and during use, by such means as may be found to be most appropriate to the particular circumstances of the manufacture. Only in very rare instances can the Board contemplate the use of pure spirit in manufacture, and then only subject to close and constant Excise supervision.

"In every case of concession, of whatever kind the persons authorised will be subject to Excise visitation, and to the observance of such regulations as regards receipt, storage, use or recovery of spirits, and the keeping of accounts of the same, as the Board may prescribe. ("*July*, 1902.")

In pursuance of the section, the privilege of receiving spirit duty free has been granted in a considerable number of cases, those of institutions for the advancement of science, or of scientific education being the most numerous.

X.—TABLE showing for the United Kingdom the BUDGET ESTIMATES and the NET RECEIPT OF DUTY ON HOME-MADE SPIRITS in the period 1892–93 to 1902–03.

Year ended 31st March.	Budget Estimate of the Amount Receivable by the Exchequer.	Net Receipt.		
		Due to the Exchequer.	Due to the Local Taxation Accounts.	Total of Columns 2 and 3.
	1.	2.	3.	
	£	£	£	£
1892–93 ...	15,500,000	15,284,067	766,102	16,050,169
1893–94 ...	15,140,000	15,189,345	761,2:2	15,950,637
1894–95 ...	15,600,000	15,269,296	7:2 403	16,001,699
1895–96 ...	15.200,000	15,603.670	776,455	16,380 134
1896–97 ...	15,800,000	16,013,412	803,072	16,816,484
1897–98 ...	16 250,000	16,396,725	822,181	17.218,906
1898–99 ...	16,750,000	17,109,273	857,869	17,967,142
1899–1900	17,420,000	19,335,360	967,787	20,303,147
1900–01 ...	19,000,000	19,206.689	917,314	20,124,003
1901–02 ...	18,800,000	17,647,421	843,358	18,490,779
1902–03 ...	18,500,000	18,164,359	868,937	19,033,296

XI.—TABLE showing, for England, Scotland, and Ireland, and for the United Kingdom, the NET RECEIPT OF DUTY ON HOME MADE SPIRITS in the period 1892–93 to 1902–03.

Year ended 31st March.	England.	Scotland.	Ireland.	United Kingdom.
	£	£	£	£
1892–93 ...	6,586,298	5,351,835	4,112,036	16,050 169
1893–94 ..	6,373,096	5 461,198	4,116,343	15,950,637
1894-95*...	6,304,995	5,591,907	4,104,797	16,001,699
1895-96†...	6,352,963	5,858,694	4,168,477	16,380,134
1896–97 ...	6,454,401	6,132,866	4,229,217	16,816,484
1897–98 ...	6.532,765	6,399,919	4,286,222	17,218.906
1898–99 ...	6,853,314	6.783,802	4,330,026	17,967 142
1899-1900‡	7,470,598	7,793,387	5,039 162	20,303,147
1900–01 ..	7,566 262	7,650,675	4 907,066	20,124,003
1901–02 ...	6,830,279	7,292,312	4.368,188	18,490,779
1902–03 ...	6,860 355	7,658,684	4,514.257	19,033,296

Alterations in Rates of Duty on Home Made Spirits.

* Year 1894-95: Duty increased from 10s. 6d. to 11s. a gallon per Act 57 and 58 Vict. c. 30.

† Year 1895-96: Duty reduced to 10s. 6d. per gallon from 1st July, 1895.

‡ Year 1899-1900: Duty increased to 11s. per gallon from the 6th March, 1900, per Act 63 and 64 Vict. c. 7.

Including the 6d. per gallon allocated to the Local Taxation Accounts which was imposed by the Act 53 and 54 Vict. c. 8 and remains unaltered.

Having dealt with the net receipt of duty in the period 1892-93 to 1902-3, we now proceed to furnish figures relative to the production and the consumption of spirits. We are not in a position to supply information as to the *bulk* quantities of spirits produced or consumed, and all the figures given in the Tables represent quantities in gallons at proof strength.

XII.—Table showing the numbers of Proof Gallons of Home-made Spirits in each part of the United Kingdom during the period 1892-93 to 1902-03.

Year ended 31st March.	England.	Scotland.	Ireland.	United Kingdom.
	Proof gallons.	Proof gallons.	Proof gallons.	Proof gallons.
1892-93 ...	10,691,579	20,107,077	13,615,668	44,414,321
1893-94 ...	10,182,675	21,472,441	13,293,078	44,941,194
1894-95 ...	9,954,964	22,235,958	12,679,435	44,870,357
1895-96 ...	10,999,545	24,712,790	13,612,540	49,324,875
1896-97 ...	11,821,182	28,518,681	14,282,843	54,622,706
1897-98 ...	12,360,255	33,744,503	14,547,708	60,652,466
1898-99 ...	12,913,771	35,769,114	14,754,999	63,437,884
1899-1900	12,966,941	31,798,465	14,480,871	59,246,277
1900-01 ...	12,603,311	30,196,016	14,221,520	57,020,847
1901-02 ...	12,438,596	29,973,193	12,780,535	55,192,324
1902-03 ...	11,295,563	26,007,569	12,441,298	49,744,430

The estimated quantities of materials used in distilleries (United Kingdom) in the year ended 30th September, 1902, were:—

Materials.	Quantities.
Malt	1,177,985 qrs.
Unmalted Grain	1,330,387 ,,
Rice	20,382 cwts.
Molasses	711,599 ,,
Glucose	640 ,,
Sugar	9,588 ,,
Other Materials	13,206 ,,

XIII.—Table showing the Numbers of Proof Gallons of Home-made Spirits remaining in Warehouses on the 31st March in each year of the Period 1892-93 to 1902-03, and on which Duty had not then been paid:—

Year ended 31st March.	England.	Scotland.	Ireland.	United Kingdom.
	Proof gallons.	Proof gallons.	Proof gallons.	Proof gallons.
1892-93 ...	10,606,507	58,504,023	30,645,222	99,755,752
1893-94 ...	10,667,355	61,275,754	31,370,099	103,313,208
1894-95 ...	10,862,765	65,073,328	32,259,309	108,195,402
1895-96 ...	11,179,039	69,616,136	33,315,526	114,110,701
1896-97 ..	11,594,213	77,172,675	34,741,027	123,507,915
1897-98 ...	11,973,960	89,758,837	35,943,678	137,676,475
1898-99 ...	12,198,240	103,290,391	36,243,908	151,732,539
1899-1900	12,132,304	109,898,389	35,139,275	157,169,948
1900-01 ...	11,905,058	114,853,325	34,744,446	161,502,829
1901-02 ...	12,606,895	119,948,047	34,456,792	167,011,734
1902-03 ...	12,637,979	120,342,958	33,545,782	166,526,719

XIV.—Table showing the numbers of Proof Gallons of Home-made Spirits on which Duty was paid in each part of the Kingdom in the period 1892-93 to 1902-03.

Year ended 31st March.	England.	Scotland.	Ireland.	United Kingdom.
	Proof gallons.	Proof gallons.	Proof gallons.	Proof gallons.
1892-93 ...	13,003,880	10,537,160	7,851,844	31,392,884
1893-94 ...	12,632,227	10,740,546	7,850,071	31,222,844
1894-95 ...	11,982,512	10,546,318	7,504,688	30,033,518
1895-96 ...	12,641,480	11,367,671	7,896,979	31,906,130
1896-97 ...	12,920,226	11,962,642	8,065,580	32,948,448
1897-98 ...	13,102,404	12,434,265	8,176,459	33,713,128
1898-99 ...	13,790,512	13,137,396	8,260,616	35,188,524
1899-1900	15,019,384	15,021,027	9,589,571	39,620,982
1900-01 ...	14,619,040	14,157,036	8,931,877	37,707,953
1901-02 ...	13,302 230	13,505,411	7,952,740	34,760,381
1902-03 ...	13,500,675	14,181,145	8,215,355	35,897,175

The duty is not paid until the removal of the spirits from warehouse. The quantities on which the duty is paid include spirits subsequently warehoused on drawback for exportation, &c., and do not correspond with the quantities retained for consumption, figures as to which appear in the following Tables:—

XV.—Table showing the Quantities of Home-made Spirits retained in England, Scotland and Ireland, and the United Kingdom, for Consumption, in the period 1892-93 to 1902-03.

Year ended 31st March.	England.	Scotland.	Ireland.	United Kingdom.
	Proof gallons.	Proof gallons.	Proof gallons.	Proof gallons.
1892-93 ...	19,935,434	6,445,771	4,279,793	30,660,998
1893-94 ...	19,765,125	6,422,289	4,264,968	30,452,382
1894-95 ...	19,231,943	6,019,430	4,039,927	29,291,300
1895-96 ...	20,376,084	6,490,043	4,222,321	31,088,448
1896-97 ..	21,296,789	6,622,190	4,207,259	32,126,238
1897-98 ...	21,981,562	6,760,037	4,156,674	32,898,273
1898-99 ...	23,145,797	7,078,514	4,109,773	34,334,084
1899-1900	25,623,177	8,380,378	4,713,178	38,716,733
1900-01 ...	24,993,993	7,471,401	4,238,334	36,703,728
1901-02 ...	22,826,871	7,115,121	3,807,239	33,749,231
1902-03 ...	23,356,933	7,399,424	4,008,778	34,765,135

It should be pointed out that as regards the year 1899-1900, in consequence of a rise in the duty being anticipated (a rise which actually took place on the 6th March, 1900) there was an abnormal withdrawal of spirits from warehouse, and consequently the figures appearing in the above Table for that year are inflated to a corresponding extent. The same cause operated in 1900-01. For the year 1901-02, the table shows an apparent falling off in the consumption, but this diminution is not real, as the stocks withdrawn by traders in excess of the normal rate of consumption in 1899-1900 and 1900-01 were in course of consumption in the financial years immediately succeeding, thereby rendering unnecessary in 1901-02 withdrawals from warehouse to the same extent as in the two years mentioned.

The figures in the foregoing Table are arrived at after taking into consideration the removals of spirits from one part of the kingdom to another, which are shewn in the following statement for the year 1902-03:—

TABLE XVI.

	England.	Scotland.	Ireland.
	Proof gallons.	Proof gallons.	Proof gallons.
Spirits on which duty was paid in each country	13,500,675	14,181,145	8,215,355
Spirits imported from England, duty paid	—	31,385	40,465
Spirits imported from Scotland, duty paid	7,210,410	—	33,620
Spirits imported from Ireland, duty paid...	3,697,765	582,892	—
	24,408,850	14,795,422	8,289,440
Deduct:—			
Spirits sent to England	—	7,210,410	3,697,765
Spirits sent to Scotland	31,385	—	582,892
Spirits sent to Ireland	40,465	33,620	—
Spirits warehoused on drawback for exportation, &c....	980,067	151,968	5
	1,051.917	7,395,998	4,280,662
Spirits retained for consumption in each country.	23.356,933 Proof gallons.	7,339,424 Proof gallons.	4,008,778 Proof gallons.

SUMMARY.

United Kingdom.

	Proof gallons.
Spirits on which duty was paid	35,897,175
Deduct—	
Spirits warehoused on drawback for exportation, &c.	1,132.040
Spirits retained for home consumption ...	34,765,135 proof gallons.

So far we have dealt in the preceding Tables with figures of home-made spirits. I now give a Table showing the consumption in the United Kingdom of all kinds of spirits, whether Home-made, Colonial, or Foreign, with the estimated consumption per head of the population.

METHYLATION.

XVII.—TABLE showing, for England, Scotland, and Ireland, and for the United Kingdom, the NUMBER OF PROOF GALLONS OF HOME-MADE AND COLONIAL AND FOREIGN SPIRITS METHYLATED in the period 1892–93 to 1902–03.

Year ending 31st March.	England.	Scotlan6.	Ireland.	United Kingdom.
Home-made Spirits.				
	Proof gallons.	Proof gallons.	Proof gallons.	Proof gallons.
1892–93 ...	2,498,118	362,177	29,022	2,889,317
1893–94 ...	2,763,036	309,962	33,883	3,106,881
1894–95 ...	2,840,278	263,987	34,789	3,139,054
1895–96 ...	3,492,645	309,674	35,763	3,838,082
1896–97 ...	3,664,125	411,917	42,832	4,118,874
1897–98 ...	3,943,582	476,824	40,456	4,460,862
1898–99 ...	4,149,128	587,088	45,153	4,781,369
1899–1900	4,280,437	646,664	50,926	4,978,027
1900–01 ...	4,329,214	692,486	49,013	5,070,713
1901–02 ...	4,010,334	575,606	54,830	4,640,770
1902–03 ...	3,574,732	605,012	59,944	4,239,688
Colonial and Foreign Spirits.				
1892–93 ...	562,792	77,655	5,070	645,517
1893–94 ...	361,272	74,145	1,288	436,705
1894–95 ...	340,456	107,493	...	447,942
1895–96 ...	21,536	69.305	1,149	91,990
1896–97 ...	24,163	273	...	24,436
1897–98 ...	1,706	...	...	1,706
1898–99 ...	3,045	735	...	3,780
1899–1900	5,710	535	...	6,245
1901–01 ...	120,332	...	...	120,332
1901–02 ...	519,325	108,085	...	627,410
1902–03 ...	1,120,115	91,886	...	1,212,001
Total Home-made and Colonial and Foreign Spirits.				
1892–93 ...	3,060,910	439,832	34,092	3,534,834
1893–94 ...	3,124,308	384,107	35,171	3,543,586
1894–95 ...	3,180,734	371,480	34,789	3,587,003
1895–96 ...	3,514,181	348,979	36,912	3,930,072
1896–97 ...	3,514,181	412,190	42,832	4,143,310
1897–98 ...	3,945,288	476,824	40,456	4,462,568
1898–99 ...	4,152,173	587,823	45,153	4,785,149
1899–1900	4,286,147	647,199	50,926	4,984,272
1900–01 ...	4,449,546	692,486	49,013	5,191,045
1901–02 ...	4,529,659	613,691	54,130	5,268,180
1902–03 ...	4,694,847	696,898	59.944	5,451,689

I will now show on the screen some illustrations photographed for me by Messrs. R. and J. Beck, Cornhill. The Tables are taken from the report of the Paris Congress in the applications of denatured alcohol organised by the Automobile Club of Paris in December, 1902. The illustrations of motors and farming appliances are copied from Professor Meyer's (Charlottenburg) report on spirit-locomotives, Berlin, 1903, and Herr Olchmann's report on spirit-wagons, and serve to show the enormous advances made within the last few years.

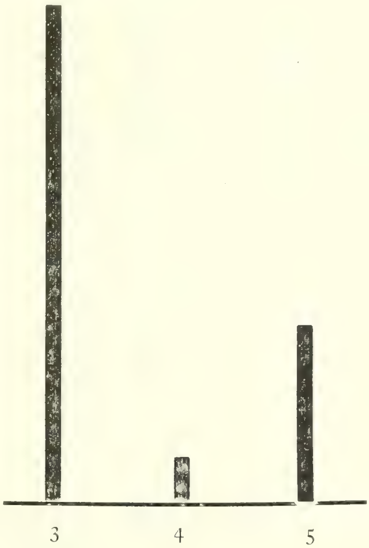
SUPPLEMENT A.

ALLEMAGNE (1901).

		Hectos.
1.	Production totale	4.060.000
2.	Emplois Industriels	1.161.300

FRANCE (1900).

		Hectos.
3.	Production totale	2.656.000
4.	Emplois industriels	221.214
5.	Dans la même proportion qu'en Allemagne, ils devraient être de	742.000



DISCUSSION.

The CHAIRMAN said that there was a mass of ıformation in the paper which was of peculiar alue, as Mr. Tyrer had hit the psychological ıoment. There was just now an important meeting f Members of Parliament taking place to consider ı what form the Finance Bill would be best dealt with, ith a view to bringing about the object which Mr. 'yrer was advocating. He hoped the result of Mr. 'yrer's advocacy would be the bringing of free lcohol forward as an important asset of British rosperity. There was a common impression that Iembers of Parliament knew pretty well everything, nd the members encouraged that popular delusion; ıt he was satisfied that the information which Mr. 'yrer had given in the paper would be new to ıany of them, and he believed that, as a result f it, there would be a great flood of oratory in ıe House of Commons on the subject. As a hemical manufacturer he had been very much ıterested for many years in goods in which lcohol took part, and he regretted to say that, owing to the duty which had prevailed in this country his firm had been unable to compete with German manufacturers in regard to such goods. He felt appalled when he looked at the long list of products which Mr. Tyrer had pointed out, and remembered that although many of them had been invented by English chemists, and in their experimental stage had been produced in this country, they did little now to add to the prosperity and industry of this nation. He was bound to say that he did not think it would be possible to recover the trade in many of these products. The foreigners had so well established themselves in the production of them, and had the run of the market for years without any opposition from the British manufacturer, so that it would be almost impossible to recapture the market. But still he believed that there was a wide field in front of English manufacturers for cheap alcohol, and that we were only on the threshold of what would be the ultimate application of the material to the arts and sciences. Next to benzole there was no organic body which lent itself as alcohol did to synthetic and many other chemical operations. It also lent itself to mechanical

Supplement B.—Statistique de l'Alcool depuis 30 Années.

Années. L'hecto logé jusque fin Août 1882.	Prix Moyen à l'hectolitre les 90° Entrepot Paris.	Production en Hectolitres.				Consommation en Hectolitres.	Exportation en Hectolitres.	Importation en Hectolitres.
		Alcool de Betteraves.	Alcool de Mélasses.	Alcool de Grains.	Alcool de Vins, Fruits, and Marcs.			
1873	62,06	262.625	691.971	176.686	371.350	1.649.288	Comprise	40.114
1874	64,30	333.614	707.062	190.995	41.644	1.457.156	,,	52.282
1875	49,63	397.521	641.911	173.288	631.166	1.779.071	,,	62.313
1876	50,76	345.033	684.734	145.484	845.650	1.458.901	542.210	62.363
1877	59,90	168.324	664.517	200.106	150.909	1.059.238	335.676	90.150
1878	60,40	319.736	656.049	197.777	262.840	1.228.993	296.081	117.550
1879	59,49	381.803	718.532	254.040	227.411	1.522.932	281.520	168.302
1880	66,77	313.566	709 925	398.011	24.545	1.454.605	342.530	282.896
1881	62,40	499.108	666.057	507.785	43.781	1.697.718	270.399	232.983
1882	56,63	571.463	714.786	447.634	60.938	1.734.479	257.457	309.539
1883	50,26	579.858	723.918	552.091	45.205	1.843.382	254.608	157.131
1884	43,82	608.419	768.751	519.593	94.979	1.841.027	251.472	182.684
1885	46,84	484.876	776.593	537.243	94.979	1.796.827	271.715	200.922
1886	44,74	525.317	492.093	781.817	103.362	1.856.600	269.581	220.166
1887	42,37	793.006	426.462	761.458	87.769	1.992.788	287.730	234.569
1888	43,91	533.418	579.135	851.896	104.914	1.836.479	272.218	152.083
1889	39,46	739.572	576.390	764.583	107.818	2.005.617	300.923	137.627
1890	35,71	915.770	622.121	686.140	79.977	2.084.334	336.542	133.437
1891	41,47	742.571	851.731	459.150	90.876	2.017.599	327.154	141.042
1892	47,03	917.858	872.611	366.087	126.238	2.183.947	319.435	136.722
1893	44 ,,	756.826	936.440	448.419	137.436	2.007.170	276.890	160.283
1894	33,63	817.132	772.470	439.783	405.163	2.177.347	278.613	144.443
1895	31,15	777 964	869.949	387.827	217.122	1.959.134	271.131	154.832
1896	30,82	689.241	838.329	414.116	167.128	2.011.948	328.202	126.162
1897	38,11	536.377	790.099	473.932	227.514	2.063.116	281.107	131.805
1898	45,95	823.558	721.781	613.867	104.538	2.053.361	282.323	134.067
1899	41,73	997.550	664.012	717.324	155.039	2.293.481	295.459	115.810
1900	35,35	1.040.691	746.888	623.367	230.559	2.467.153	338.550	119.803
1901	28,29	942.281	932.134	321.492	603.639	2.264.933	327.218	96.794
1902								

operations, for after all solution was a more or less mechanical matter. There were many new industrial appliances cropping up nearly every day in which cheap alcohol might be used. In the matters of heating, production of power, and illumination, the value of alcohol was inestimable. He was not quite satisfied with regard to the statement in the paper relating to the relative heat value of alcohol, but he was sure Mr. Tyrer would not have committed himself to a statement on that subject unless it was accurate. At the present moment, the need of cheap alcohol was in the direction of the production of power. Petrol was getting dearer and scarcer, and its quality was denser, and rendered it less applicable for power purposes, and the time was very ripe for the adaptation of some substitute or at any rate some auxiliary in connection with motor-cars or other motor machinery. Cheap alcohol had proved itself to be admirably suited for motor engines. It had many advantages over petrol. It was undoubtedly safer; it had a lower flash point and it was sweeter and more wholesome, and he was under the impression that the products of combustion were less noisome that those of petrol. That part of the paper which dealt with the efficiency of alcohol for power purposes was extremely interesting. Alcohol was put down as giving an average duty of from 24 to 28, as against petrol, which was given as 13, and as against benzine which was given as 14 to 18. He was not quite sure that he should care to father those figures. But here again he had great faith in Mr. Tyrer, though unless there was some phenomenon in connection with the endo-thermicity or the exo-thermicity of alcohol when it was under combustion he could not make up his mind to accept these figures yet. But when he remembered the enormous industry in Germany in the production of absolute alcohol, not from a distiller's point of view but from an agriculturist's point of view, he could not help thinking that this country ought to

Supplement C.—Alcools appliqués a l'Industrie.

Etat des Quantités d'Alcool (Alcool pur) soumises au Droit de Dénaturation depuis 1890.

Désignation des Produits.	1890	1891	1892	1893	1894	1895	1896	1897	1898	1899	1900
	hectol.	hectol.	hectol.	hectol.	hectol.	hectol.	hectol.	hectol.	hectol.	hectol.	hectol.
Alcools de chauffage et d'éclairage	41.430	51.773	57.022	58.692	67.224	70.570	73.379	80.411	93.906	169.767	125.648
Vernis	12.470	11.781	10.876	11.740	11.205	11.845	12.488	13.133	15.657	87.395	14.762
Alcools d'éclaircissage (ébénisterie	2.510	4.214	1.145	1.715	1.253	938	1.627	1.713	2.506	1.287	2.750
Matières plastiques (celluloïd, phibrolithoïd, etc...	1.820	1.363	1.316	1.603	1.276	2.200	2.806	3.508	9.635	9.430	7.198
Chapellerie	635	592	523	801	575	555	600	570	384	304	413
Teintures et couleurs	432	210	377	450	268	184	216	176	185	188	156
Présure liquide	98	115	82	108	101	113	99	115	182	145	123
Collodion	210	198	175	199	262	141	167	96	115	123	186
Chloroforme	196	280	215	304	286	239	128	129	250	226	52
Chloral	152	167	125	129	121	167	159	126	137	210	308
Tannins	109	130	118	140	153	149	150	154	163	195	496
Produits chimiques, pharmaceutiques et produits divers (extraits alcaloïdes, insecticides, savons transparents, etc.).	676	640	598	623	605	539	616	984	1.435	1.918	3.863
Usages scientifiques	231	255	280	237	333	327	371	383	550	492	386
Ethers, fulminates de mercure, explosifs, etc.	48.873	37.064	32.095	30.198	37.136	46.273	45.764	45.031	48.184	74.263	64.873
(1901 : 251.180). Totaux...	109.842	105.782	104.947	106.939	120.798	131.240	138.560	146.529	173.298	216,015	221 214

wake up to the advantages which might be obtained from the production in it of cheap alcohol. This was especially so when they considered the unprofitable character of farming in this country. If the thousands of acres of land in this country. which could not now be cultivated profitably could be made to grow potatoes or cheap cereals for alcoholic production, the land might, in the language of the good old Book, be made to smile again. The opportunities were great and the advantages were obvious, and he could not for the life of him think that when the matter came before the House of Commons any difficulty could possibly stand in the way of the realisation of the dream which his friend Mr. Tyrer had had in his mind for the last fifteen years.

Dr. Boverton Redwood said that he ventured to think that this was essentially a matter in which concerted action and mutual co-operation were absolutely needed if they were to have any prospect of success. It was a matter in respect of which it was eminently desirable to disarm opposition. It had been brought to his knowledge that some of those persons who were commercially interested in petroleum appeared to be under the impression that the supporters of the new movement for using cheap alcohol for purposes for which petroleum was now employed were dangerous competitors who were seeking to attack vested interests. Such an attitude was obviously unfortunate, and, he submitted, wholly unjustifiable. He was confident a little reflection would satisfy them of the general truth of the assertion that as one multiplied facilities the desire to take advantage of those facilities was also multiplied in a more than corresponding degree. He was sure that if it was possible to make use of alcohol as a source of power in internal combustion engines or as a source of light and heat, those persons who were interested in the sale of petroleum products would find that the volume of their business or of their profits was not sensibly diminished. The fact was, that the more facilities people had the more they wanted. The appetite grew in the act of eating. This truth, he was confident, applied to the various applications of alcohol; and therefore, they could only satisfy the apprehensions of those who were disposed to object to the steps which were being taken towards the utilisation of cheap alcohol, but they could confidently invite the objectors to help in the work which had been taken in hand. It would be very desirable that in addition to the

various committees which had been already formed to deal with the subject of duty-free alcohol, and to procure the removal of existing restrictions, there should be some general committee on which all the various interests should be represented. Such a committee would afford an opportunity for removing by means of friendly discussions those objections which were still entertained. The work which would be thus carried on, would be shown to be a national work of great importance, and unless there was mutual co-operation and concerted joint action of the kind indicated, Mr. Tyrer might have to continue for a considerable further time, those labours which he had already voluntarily and so ably undertaken. He fully endorsed the remarks which had fallen from the Chairman, as to the exceedingly valuable character of the paper.

Mr. W. F. Reid thanked Mr. Tyrer for the good work he had done. One point which had not been touched upon as fully as it might have been, was the very great importance of the utilisation of the products of the soil in connection with industries, and especially with the production of alcohol. He believed that no effort was made in this country to produce alcohol from potatoes. What did that fact mean? The large distilleries of this country were worked with imported grain. If we utilised potatoes on a large scale for the production of alcohol, we should have an enormous fund of grain to draw upon for use in case of war. With regard to alcohol made from potatoes, that alcohol did not come out of the land at all, but it all came out of the atmosphere, and the whole of the residue after the alcohol had been manufactured could be restored as manure to the land or used for the feeding of cattle, so that this form of industry would really improve the land instead of deteriorating it. The practical thing to which they must address themselves was, he thought, the endeavour to persuade the Chancellor of the Exchequer and the authorities that there would be no loss of revenue caused by granting duty-free spirit for industrial purposes. The loss that might accrue would be caused by the dishonest use of denatured spirit for potable purposes; but he thought that that form of loss would be very remote, and would be infinitesimal compared with the advantages which would be derived by manufacturers. Experience abroad showed that loss from the dishonest use of free alcohol for drinking was very improbable. Notwithstanding the immense quantity of free alcohol allowed for German manufacturers the number of persons convicted in Germany for defrauding the revenue by the improper use of the alcohol in the course of a year was only 84, and the fines amounted to £2,300. This showed that fraud was not very probable. He did not think that we were justified in assuming that people would be less honest in this country than in Germany. The Society of Chemical Industry had been agitating in this matter in connection with the London Chamber of Commerce, and those bodies had formed a committee. That committee might be extended so as to embrace the Society of Arts, the Automobile Club, and the Royal Agricultural Society. A joint committee of all those bodies would be of very great influence, and would constitute a means of giving to the Government information which they did not now possess. He did not think that the Government authorities held back on account of a want of wish to meet manufacturers. He believed that it was from a want of knowledge. The authorities would consider applications for the use of untaxed alcohol from persons engaged in an industry of such magnitude that it had a public interest in its bearing upon national trade. But how could a person who wished to start an industry which required the use of untaxed alcohol persuade the authorities that his industrial enterprise was of such magnitude as to be of national importance? There must be a beginning. Persons wanting to start an industry ought to be allowed the use of say 100 gallons a month free of duty. He did not wish to complain of the Government officials. Those persons had done all they could to help the manufacturers within the limits imposed upon them by law. There was another point which ought not to be lost sight of. Absolute alcohol was allowed to be used free of duty in many of our college laboratories at the present time. That was a very great concession, but he believed that the whole of the absolute alcohol thus used was made in Germany. It would be well if the distillers of this country would put themselves into communication with the gentlemen in this country who were leading in this matter. When Mr. Tyrer started the agitation for duty-free alcohol, some of the English distillers were doubtful as to whether it would be to their advantage or not, but the distillers were now unanimously in favour of the new movement. The production of alcohol was now very much greater than the demand. The use of the spirit for potable purposes was, he was very glad to say, falling off. If the production was now greater than the consumption, there was need for a fresh outlet for the surplus. There was one concession which distillers needed before they could compete with Germany. They were now only allowed to turn out about 50 per cent. of the quantity of alcohol which their plant could produce. This doubled the expense at the outset. If they were allowed to have a freer hand in the production of the spirit, especially for trade purposes, they could make it more cheaply. With regard to the use of alcohol for lamps, he did not think that any one could wish to have a better light than was now burning in that hall. The alcohol lamp was far safer than the petroleum lamp, and it could be extinguished by water.

Mr. W. H. Massey said that he took a great interest in the potato spirit question. He had been trying alcohol lamps for two or three months. The cost of burning was about 6d. for ten hours, with an average candle-power of a little over thirty. The

:ost stated in electrical terms was equal to 5d. a unit. The cost in England was twice as much as the cost n Berlin. One firm in Berlin sold between October and January last 50,000 lamps similar to those on the table.

Dr. O. SILBERRAD said that the difference in relative efficiency for power between petroleum and alcohol lay mainly in the fact that alcohol, on explosion in the cylinder, produced less carbon monoxide than petroleum. As that gas was poisonous it was obviously a good thing to avoid its formation. The use of alcohol for industries divided itself into two heads. First, there were those preparations which contained alcohol as such, and of course these must pay duty. Then came the substances in which the alcohol was used up in the manufacture. In these cases it was either wasted or destroyed. The manufacture of these was simply driven out of the country. Until quite lately even research on a small scale was labouring under the disadvantage of having to use alcohol on which duty had been paid. Research was practically the breath of life to chemical industry. It rested in the hands of the excise authorities to permit denatured alcohol for scientific purposes. A concession in the alcohol laws would lead to increased national wealth. The importance of the question could hardly be overstated.

Mr. A. R. SENNETT said that the calorific value of a fuel in connection with the internal combustion engine was not everything. The facility with which the energy could be got out of the fuel was much more important. The reason a better return was got from alcohol than from petrol was that the combustion was slower. The internal combustion engine, when it used alcohol, began to approach more to the nature of the steam engine. The difference in action was comparable to that between ordinary gunpowder and large-grained, slow-burning powder. He believed that the most important point which had been touched upon, was the appointment of a proper committee. As a member of the Alcohol Committee of the Automobile Club, he would urge this matter upon the author. The committee ought to be thoroughly representative.

Mr. H. J. HELM said that, as a matter of fact, distillers produced from 5 per cent. to 20 per cent. more than their estimated amount of alcohol. As to the recovery of methylated spirit, it was practised almost universally. The alcohol used in the manufacture of fulminate of mercury was also recovered. As to new industries, it was the practice of the revenue department, when application was made, to permit the use of untaxed methylated spirit up to one thousand or five thousand gallons for experimental purposes. As to the use of potatoes by the distiller there was no objection to it, if it was thought to be economical, but in this country it was not thought to be so. It was a great pleasure to hear that the question of free alcohol was to be taken up by Parliament, for it was from that body that the real initiative must come.

Mr. B. BIGGS said that before the price of alcohol at the distillery could be reduced distillers must either double their output, or abolish half their plant. Some means must be provided by which the distiller should be able to recoup himself in some way for not being allowed to work his plant fully under all circumstances. He thought that if the choice of materials was extended, and it was necessary to modify existing plant, some principle of compensation should be adopted as in the case of licences.

On the proposal of the CHAIRMAN, a hearty vote of thanks was accorded to Mr. Tyrer.

Mr. TYRER replied. As to the appointment of a committee to promote the proposals made, he said that a committee appointed by the London Chamber of Commerce and the Society of Chemical Industry already existed. There could be little disadvantage in adding to the joint committee members of other interested bodies. It was a fact that the revenue authorities, in order to avoid continued references to the Department on new questions, had suggested that Chambers of Commerce were very suitable bodies to focus opinions and approach the authorities. This course had been adopted with distinct advantage by the chemical trade of London through the Chemical Committee of the London Chamber.

Correspondence.

THE REPRESSION OF THE BRITISH INVENTOR.

My sole object in addressing the Society of Arts was to help the inventors of my native land, knowing they have the ability but lack encouragement and opportunity. I am an inventor, not an advocate, and have no gift for perversion or quibbling; neither have I any desire to raise invidious comparisons.

Great Britain and her Colonies are not holding their former prestige in the mechanic arts. True patriots admit it and seek the cause. It is not degeneracy, for under other conditions they are still the leaders. If the Society of Arts can fathom the difficulty and supply a remedy, it were better than adding a new empire to the Crown.

Some time ago, a manager of the largest corporation in the United States asked me to make a tour of their plants, but I said: "I know nothing whatever about the making of your products." He replied: "That is the very reason we want you. Our people are so satisfied with present methods, we can look for no material improvement from them."

It is a fact that radical changes do not come from within; the onlooker sees more of the game. So the

Society must not expect much assistance or even kindly consideration from the patent fraternity if they attempt to regenerate them. "There are none so blind as those who won't see."

The facts and figures given by me were from actual experience. If they are not "the law," they are the result of laxities in the law. Where neither penalties nor odium are attached, laws bear little weight.

It would hurt no honest man if the true inventor were compelled to state on oath before a magistrate or a notary public that, to the best of his knowledge, he was the sole and original inventor. The paternal feeling of ownership which some employers have for their workmen easily surmounts mere matters of form, but perjury is too serious a thing to juggle with.

The law says the inventor's name shall "appear" in the application. That is very nice of the law; but why should several other names be permitted to appear in the application. How many workmen would have the temerity to combat an employer who neglected to have his (the workman's) name appear?

I gave no cost for obtaining patents in the United States, but merely gave the Government fee, which is $8, aad stated that the office was now over $2,000,000 ahead of its outlay, to show that it was possible for the British Government to establish a good patent system, and issue a marketable patent certificate without drawing on the Treasury Department; and while the United States and German patents are not, in banking parlance, certified checks, they are the next "highest rating," and have a commercial standing which a British patent, unsupported by the United States or German patent, does not approach. The value of an article does not depend on its cost, but on the disposition you can make of it.

Occasionally, a United States patent is declared "invalid" because some inventors wait until their machine is perfected before applying for a patent, while others apply as soon as they have the conception; so it sometimes happens that the one with only the conception gets a patent for a machine which another has really in operation, and when the latter applies for his patent, an interference is declared. The Office calls for testimony, and awards the patent to the prior inventor, declaring the first issue invalid.

As a rule, the examiners are so enthusiastic in their work, and so great is their pride in the branch of the art under their supervision, that they give much of their own time and many of their holidays to studying its history and development. The manufactories of the country are at all times open to them, and they are frequent and inquisitive visitors. Many of our best patent solicitors have been examiners, and it is the ambition of all the young men in the Office to graduate through it either into an established firm or a practice of their own, it behoves them to have a reputation for ability and fairness with the inventors and their attorneys.

To give an example of the thoroughness of the knowledge:—On a recent application of mine, the were no references in the Patent Office, but th examiner cited a letter of Benjamin Franklin to friend in Paris (now in the Congressional Library which necessitated the limiting of some of my claim They know they are there to foster the arts, so the are exceedingly cautious and painstaking. The gladly allow the inventor all he can show he h invented, but must protect the public by refusin claims broad enough to cover past inventions or th future growth of the arts.

GEORGE ARCHIBALD LOWRY.

Boston, Mass.

AGRICULTURAL EDUCATION.

The paper on "Agricultural Education," by Mr. C. Medd, and the discussion thereon, are interestin as showing how the primary cause of agricultur neglect can be forgotten even by our teachers!

In a few isolated cases, the "vertical unity" ma obtain, but under the present Land Laws, th "horizontal" never; and this brings us to the caus

It is to no man's interest to farm rented land. Th owners have driven the farmer off the land; and, ti there is a drastic alteration in reference to ownershi of land, agriculture is bound to dwindle away, an education is more likely to add to, than stop th migration into towns.

I know of large tracts of land that were unde cultivation years ago, and are now practically idl and why? No man can see a profit in it. A few ba seasons, the highest obtainable rent, taxes, damag done by hunting, and generally an increased ren following improvements, have ruined too many.

An impartial investigation would probably sho that in every case where a farmer's son is attendin an agricultural school, the farmer is owner of h farm, or his son is preparing for emigration to on of the colonies.

The sons of tenant farmers are seldom kept a home, or on the land; the father's experience of th drudgery, early and late, winter and summer, and ren day, compels him, out of sheer humanity, to see tha his sons do not enter a life of finding money for landlord. This is the practical side of the questior and must be faced.

GEO. F. CHUTTER.

23, Hampden road, Hornsey, N.
18th April, 1904.

Obituary.

SIR CLEMENT LE NEVE FOSTER, D.SC., F.R.S —Sir Clement Le Neve Foster, whose death too place on the 19th inst., had very intimate associatior with this Society, his father, the late Mr. Peter L Neve Foster, having been Secretary for 26 year

until his death in 1879. As far back as 1860 he communicated a note to the *Journal* on a process for extracting silver, but it was not until 1887 that he actually became a member. In 1892 he became a Member of Council, and ten years later—in 1902—he was again elected to the same office. For a great many years he was a frequent attendant at the Society's meetings, and often took part in the discussions—on several occasions he took the chair.

He was born at Camberwell in 1841, was educated in France, and took the degree of Bachelier ès Sciences of the University of France. He passed through the Royal School of Mines, where he took many prizes, and left a brilliant record. Thence he went to the Mining College of Freiberg. In 1860 he was appointed on the Geological Survey, and for five years was engaged in field work in Kent, Sussex, and Yorkshire. In 1865 he took the degree of Doctor of Science at the University of London. After serving for a time as Lecturer to the Miners' Association of Cornwall and Devon, and as Secretary to the Royal Cornwall Polytechnic Society, he was appointed, in 1872, H.M. Inspector of Mines for Cornwall and Devon, and eight years later he was translated to the North Wales District, where he remained until 1901. In 1890 he became Professor of Mining at the Royal School of Mines, and this post he retained until his death. He took an active part in many of the International Exhibitions, and served as a Juror at Paris in 1867, 1878, 1889, and 1900, and at Chicago in 1893. His principal work was a "Textbook of Ore and Stone Mining," which has passed through several editions. He wrote the article on mining in "The Encyclopædia Britannica." As a young man he translated from the Dutch a work on the tin deposits of Banca, learning the language of the original for the purpose. He was knighted in November last year, a year after his retirement.

His health never recovered from the shock it received from the results of an explosion in the Snaefell lead mine in the Isle of Man, in 1897. After the accident he went down with a rescue party, but they were overpowered by the fumes, and the striking of the cage in the shaft prevented their immediate recovery. For a long time they were in very great danger of suffocation, and the undaunted courage with which Mr. Le Neve Foster faced imminent death was shown by the fact that he occupied his time in making notes of his sensations and condition while he and his party were waiting the chance of rescue.

General Notes.

NATURAL VERSUS ARTIFICIAL INDIGO.—The Reporter on Economic Products to the Government of India has given in a circular the following particulars respecting the present state of the trade in indigo between India and Allepo. Between 600 and 700 chests of indigo are imported into Allepo from India every year. On account, however, of the competition of German synthetic indigo, this is usually sold by the merchants at a loss. This synthetic indigo has two advantages over the natural product, viz., that it is cheaper and that its price does not vary. It was generally thought that owing to these advantages natural indigo would be entirely replaced by the synthetic. That this has not happened is due to the fact that synthetic indigo has not the same smell as that to which the native dyers are accustomed, who are therefore prejudiced against it. Moreover, cloth dyed with it alone fades in about two mouths. The consequence is that the two forms are mixed in about equal proportions, the resulting mixture being more durable and also brighter in colour than the natural indigo. On account, however, of the impetus that has been given to the dyeing industry by the popularity of this mixed dye, much more indigo is used than formerly, and the reduction in the demand for natural indigo has not been nearly as great as might have been expected from the facts mentioned.

NEWSPAPERS AND PERIODICALS IN GERMANY.—There are now published in Germany 12,703 newspapers and periodicals—9,220 in the German language and 3,483 in other languages. Of the latter English takes the lead with 1,136 publications; then follow the French with 951; Danish, 238; Swedish, 193; Italian, 156; Polish, 147; Dutch, 130; Russian, 117; Norwegian, 99; Spanish, 87; Servian, 55; Hungarian, 48; Czech, 28; Finnish, 14; Roumanian, 14; Portuguese, 12; Flemish, 8; Greek, 7; Lithuanian, 7; Wendish, 6; Croatian, 4; Arabic, 3; Bulgarian, 3; Hebrew, 3; Turkish, 3; the remainder being in Armenian, Latin, and Slavonian. From the above it will be seen that of the 12,703 newspapers and periodicals published in Germany more than 27 per cent. are in other languages than German, 9 per cent. being in English alone.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock:—

MAY 4.—"Statistics of the World's Iron and Steel Industries." By WILLIAM POLLARD DIGBY.

MAY 11.—"Early Painting in Miniature." By RICHARD R. HOLMES, C.V.O.

INDIAN SECTION.

Afternoons, at 4.30 o'clock:—

THURSDAY, MAY 12.—"British-Grown Tea." By A. G. STANTON. The Right Hon. LORD GEORGE HAMILTON, G.C.S.I., M.P., will preside.

TUESDAY, MAY 31.—"The Economic and Industrial Progress and Condition of India." By J. E. O'CONOR, C.I.E., late Director-General of Statistics, India.

Colonial Section.

Tuesday afternoon, at 4.30 o'clock :—

May 3.—"Canada and Great Britain." By W. L. Griffith. The Right Hon. the Earl of Aberdeen, G.C.M.G., LL.D., D.C.L., will preside.

Applied Art Section.

Tuesday evenings, 8 o'clock :—

May 10.—"Crystalline Glazes and their Application to the Decoration of Pottery." By William Burton. Henry H. S. Cunynghame, C.B., will preside.

May 17.—"Pewter." By Lasenby Liberty. Sir George Birdwood, K.C.I.E., C.S.I., will preside.

Cantor Lectures.

Monday afternoon at 4.30 o'clock :—

Prof. R. Langton Douglas, M.A., "The Majolica and Glazed Earthenware of Tuscany." Three Lectures.

Lecture II.—May 2.—*The Glazed Earthenware of Florence, and the Works of the Della Robbia.*—The early history of the art in Florence—Early pieces of Florentine manufacture—The Della Robbia ware—History of Luca Della Robbia—The art of Andrea Della Robbia—The introduction of variety of colour into Della Robbia ware—Giovanni Della Robbia—The majolica of Florence.

MEETINGS FOR THE ENSUING WEEK.

Monday, May 2...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Prof. R. Langton Douglas, "The Majolica and Glazed Earthenware of Tuscany." (Lecture II.)

Royal Institution, Albemarle-street, W., 5 p.m. Annual meeting.

Engineers, in the Theatre of the United Service Institution, Whitehall, S.W., 7½ p.m. Mr. A. S. E. Ackermann, "British and American Coal-cutting Machines."

Chemical Industry (London Section), Burlington-house, W., 8 p.m. 1. Mr. T. C. Cloud, "The Determination of Minute Quantities of Bismuth in Copper and Copper Ores." 2. Mr. T. C. Cloud, "The Determination of Minute Quantities of Arsenic in Copper Ores and Metallurgical Products." 3. Prof. E. J. Mills and Mr. A. Gray, "Testing Colloids."

National Indian Association, Jehanghir Hall, Imperial Institute-road, S.W., 4½ p.m. Annual meeting.

Tuesday, May 3...SOCIETY OF ARTS, John-street, Adelphi, W.C., 4½ p.m. (Colonial Section.) Mr. W. L. Griffith, "Canada and Great Britain."

Royal Institution, Albemarle-street, W., 5 p.m. Mr. L. Fletcher, "Meteorites." (Lecture I.)

Central Chamber of Agricultural (at the House of the Society of Arts), 11 a.m.

Alpine Club, 23, Savile-row, W., 8½ p.m.

Pathological, 20 Hanover-square, W., 8½ p.m.

Photographic, 66, Russell-square, W.C., 8 p.m. Mr. J. C. Mummery, "Demonstration of Gum-Bichromate Printing."

Zoological, 3, Hanover-square, W., 8½ p.m. 1 Mr. Oldfield Thomas, "The Osteology and Systematic Position of the rare Malagasy Bat *Myzopoda aurita*." 2. Mr. F. E. Beddard, "Contributions to the Anatomy of the Lacertilia.—III. Some Points in the Vascular System of *Chamæleon* and other Lizards." 3. Mr. A. D. Imms, "Notes on the Gill-rakers of *Polyodon*."

Wednesday, May 4...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. William Pollard Digby, "Statistics of the World's Iron and Steel Industries."

Royal Archæological Institution, 20, Hanover-square, W., 4 p.m.

British Archæological Association, 32, Sackville-street, W., 4½ p.m. Annual Meeting.

Obstetrical, 20, Hanover-square, W.C., 8 p.m.

British Architects, 9, Conduit-street, W., 8 p.m. Annual meeting.

Thursday, May 5...Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Linnean, Burlington-house, W., 8 p.m. 1. Mr. J. Cash, "British Freshwater Rhizopoda." 2. Mr. J. Lewis Bonhote, "Coloration in Animals and Birds."

Chemical, Burlington-house, W., 8 p.m.

Royal Institution, Albemarle-street, W., 5 p.m. Mr. A. Hassall, "Great Britain and Europe 1763-1793." (Lecture I.)

Civil and Mechanical Engineers, Caxton-hall, Westminster, S.W., 8 p.m. Mr. C. L. Simpson, "Superheated Steam."

Chemical, Burlington-house, W., 8 p m. 1. Messrs. W. A. Bone and W. E. Stockings, "The Slow Combustion of Ethane." 2. Mr. J. S. Ford, "Note on the Hydrolysis of Starch by Diastase." 3. Messrs. T. H. Easterfield and G. Bagley, "The Resin Acids of the Coniferæ." Part I.: "The Constitution of Abietic Acid." 4. Mr. W. Ackroyd, "The Action of Radium Rays on the Halides of the Alkali Metals, and Analogous Effects Produced by Heat." 5. Mr. T. M. Lowry, "The Dynamic Isomerism of Glucose and of Galactose. Solubility as a means of determining the proportions of dynamic isomerides in equilibrium." 6. Messrs. G. T. Morgan, H. B. Winfield, and Miss F. M. G. Micklethwait, "A Study of the Substitution Products of *ar*-tetrahydro-*a*-naphthylamine, *ar*-4-bromotetrahydro-*a*-naphthylamine and *ar*-tetrahydro-*a*-naphthylamine-4-sulphonic acid." 7. Mr. F. E. Francis and Miss M. Taylor, "The Additive Products of Benzylidenaniline with Methylacetoacetic Ester and Acetoacetic Ester."

Friday, May 6...Royal Institution, Albemarle-street, W., 9 p.m. Dr. P. C. Mitchell, "Anthropoid Apes."

Architectural Association, 9, Conduit-street, W., 7½ p.m. Mr. A. E. Munby, "The Value of Science in our Architectural Curriculum."

Geologist Association, University College, W.C., 8 p.m. "The Geology of Buxton," with special reference to the Whitsuntide Excursion, by H. Arnold Bemrose, M.A., Illustrated by lantern slides.

Philological, University College, W.C., 8 p.m. Annual Meeting.

Quekett Microscopical Club, 20, Hanover-square, W.C., 8 p.m.

Physical, Royal College of Science, South Kensington, 8 p.m. 1. Mr. W. A. Price, "Experiment with Lubricating Oil." 2. Mr. W. Duddell, "Instruments for the Measurement of Large and Small Alternating Currents." 3. Exhibition of Apparatus from the National Physical Laboratory.

Saturday, May 7...Royal Institution, Albemarle-street, W., 3 p.m. Mr. D. F. Tovey, "Sonata Style and the Sonata Forms," with Musical Illustrations. (Lecture I.)

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FRIDAY, MAY 6, 1904.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

NEXT WEEK.

Monday, May 9, 4.30 p.m. (Cantor Lectures) Prof. R. Langton Douglas, M.A., "The Majolica and Glazed Earthenware of Tuscany." (Lecture III.)

Tuesday, May 10, 8 p.m. (Applied Art Section.) William Burton, "Crystalline Glazes and their Applications to the Decoration of Pottery."

Wednesday, May 11, 8 p.m. (Ordinary Meeting.) Richard R. Holmes, C.V.O., "Early Painting in Miniature."

Thursday, May 12, 4.30 p.m. (Indian Section.) A. G. Stanton, "British-grown Tea."

Further details of the Society's meetings will be found at the end of this number.

CANTOR LECTURES.

On Monday afternoon, 2nd inst., Prof. R. Langton Douglas, M.A., delivered the second lecture of his course on "The Majolica and Glazed Earthenware of Tuscany."

The lectures will be published in the *Journal* during the autumn recess.

COLONIAL SECTION.

Tuesday afternoon, May 3rd, 1904; the Hon. Sir John Alexander Cockburn, K.C.M.G., in the chair.

The paper read was "Canada and Great Britain," by W. L. Griffith.

The paper and report of the discussion will be published in a future number of the *Journal*.

EXAMINATIONS.

Since the addition in 1901 of an Elementary Grade to the Society's examinations, the Council have had before them the question of adding also a Senior Grade, a question about which there has been very considerable difference of opinion.

They have now received from the Examinations Committee the following report, which they have adopted and approved. It will be seen that the conclusions of the Committee were arrived at after consultation with the Local Committees through whose agency the examinations are carried on.

The Council therefore trust that the report may prove acceptable, and that it may be appreciated alike by those who demand a higher grade of examination, and by those who deprecate any advance on the present standard.

It is proposed that the Examination Programme shall be modified in accordance with the suggestions of the Committee and that the Examinations shall in future be arranged under the following divisions :—

1. Elementary.—Corresponding to the present Grade I.

2. Intermediate. — Corresponding to the present Grade II. Third Class and lower part of Second Class.

3. Advanced.—Corresponding to the present Grade II. First Class with upper part of Second Class.

Report of Committee.

The Committee have considered the memorandum referred to them by the Council on the 12th of October, 1903, on the subject of the Society's examinations.

With regard to the proposal for the establishment of a Senior Grade, they first of all obtained the opinions of the various Local Committees dealing with the Society's examinations, and submitted for their consideration two suggestions :

(1) The formation of a Senior Grade of a distinctly higher character than the present examination, in which Typewriting and Shorthand might be omitted, and such subjects as Commercial Law and Currency might be included.

(2) The elevation of the present standard, and the formation of the existing first and second classes into a Senior Grade. The present third class might then form an Intermediate Grade, and the present Grade I. a Junior or Elementary Grade.

As might have been expected, the opinions expressed by the Local Committees varied considerably—a large number were opposed to any alteration in the existing system; some were in favour of a new and distinctly higher grade examination; but the great preponderance of opinion was in favour of the second suggestion.

The great argument which weighed in favour of the adoption of the second proposal rather than the first, was the importance of not diminishing the value of the existing certificates. As was pointed out in the circular letter to the Committees, over 75,000 certificates have been issued by the Society during the past ten years, and it would be hardly possible to establish a superior grade to the existing examinations without considerably lowering the value of these certificates. The opinion of the Committee was originally in favour of this proposal, and now that their views have been confirmed by the expressions of opinion which have been obtained from those best qualified to judge, they have no hesitation in recommending to the Council the following modifications in the existing examination system:—

In future the Society of Arts examinations in Commercial Knowledge should consist of three divisions or stages—(1) Elementary, (2) Intermediate, (3) Advanced. The Elementary should correspond with the present Preliminary Examinations, Grade I.; the Intermediate should be so arranged as to include the present third class of Grade II., and the lower half of the second class. The Advanced should include the first class of Grade II., and the upper half of the second class. The Advanced and Intermediate stages should each be divided into two classes. The Elementary grade should be of one class only. Separate papers should be set for each stage.

For the present year it is not proposed that any alteration should be made in the existing standards. For the first class of the Advanced certificate the candidate will be expected to obtain 70 per cent. of the full marks; for the second class, 40; for the Intermediate, 70 and 35 per cent. To pass the Elementary stage, 50 per cent. of the total marks should be obtained.

It is proposed that the following new subjects should be added for the Advanced stage:—(*a.*) Commercial Law, (*b.*) Accountancy and Banking. The other subjects for both Advanced and Intermediate stages should be the same as those in which examinations are already held, namely: (1) Arithmetic, (2) English, (3) Book-keeping, (4) Commercial History and Geography, (5) Shorthand, (6) Typewriting, (7) Economics, (8) Précis-writing, (9) French, (10) German, (11) Italian, (12) Spanish, (13) Portuguese, (14) Russian, (15) Danish, (16) Chinese, (17) Japanese. Hindustani should also be added in both stages.

For the Elementary examinations the subjects will remain as now for Grade I., namely:—(1) Handwriting and Correspondence, (2) Shorthand, (3) Elementary Book-keeping, (4) Commercial Arithmetic, (5) Commercial Geography, (6) Preliminary French, (7) Preliminary German, (8) Preliminary Spanish, (9) Elements of Typewriting.

It is probable that in future years the standard for the Advanced stage ought to be very gradually raised. No elevation of the standard for the Intermediate or the Elementary stage should be contemplated.

The Committee trust that the modification in the system which they recommend will meet with the approval of the educational authorities interested in the Society's examinations, and that it will satisfy those who are anxious for a superior grade without in any way interfering with the present system, or diminishing the value of the Society's certificates, a value which the Committee believe is increasing year by year.

The examinations next year will commence on Monday, 10th April. The Time Table will be issued shortly. It is probable that five days will be required for the examinations instead of four as heretofore, and that they will therefore extend from Monday, 10th April, to Friday, 14th inclusive.

Proceedings of the Society.

NINETEENTH ORDINARY MEETING.

Wednesday, May 4, 1904; ALEXANDER SIEMENS, Member of the Council of the Society, in the chair.

The following candidates were proposed for election as members of the Society:—

Dennis, William, F.C.S., 170, Albert-road, Jarrow-on-Tyne.

Hennessy, John F., City Chambers, 243, Pitt-street, Sydney, New South Wales, Australia.

Murdock, George J., 248, Sixth Avenue, Newark, New Jersey, U.S.A.

Usher, Sir Robert, Bart., 37, Drumsheugh Gardens, Edinburgh.

Williams, Gilbert Percy, M.Inst. C.E., 14, Victoria-street, Westminster, S.W.

The following candidates were balloted for and duly elected members of the Society:—

Abel, Peter, Usine Ste. Madeleine, Trinidad, British West Indies.

Abrahams, Henry, The British Life Office, Limited, 37, King's-chambers, Angel-street, Sheffield.

Annable, Henry William Coupé, F.C.S., The Tungsten and Rare Metals Company, Limited, Queen's-road, Battersea, S.W.

Boyle, Mrs. Cecil, Avon Carrow, Avon Dassett, Leamington.

Cram, Ralph Adams, care of Messrs. Brown, Shipley and Co., 123, Pall-mall, S.W., and 53, State-street, Boston, Massachussetts, U.S.A.

Crawford-Frost, Rev. William Alfred, M.A., 1900, Green-street, Philadelphia, U.S.A.

Folker, Alfred Henry, 12, Park-road, Harlesden, N.W., and 42, Holborn Viaduct, E.C.

Forga, Alfred, A.M.I.Mech.E., Arequipa, Peru, South America.

Hayford, Casely, Anona-chambers, Axim, Gold Coast Colony, West Africa.

Hethey, G., 33, Chepstow-villas, Kensington, W.

Holloway, Thomas, Newlands, 19, Cedars-road, Clapham-common, S.W.

Kloss, Cecil Boden, Johore Museum, Johore, Malayan Peninsula.

Lennard, Thomas J., Henbury-court, near Bristol.

Lucke, Percy K., Assoc.Inst.M.M., P.O. Box 6342, Johannesburg, Transvaal, South Africa.

Pearson, Frank Loughborough, 3, Langford-place, St. John's-wood, N.W.

Ridgeway, The Right Hon. Sir Joseph West, G.C.M.G., K.C.B., K.C.S.I., 67, Mount-street, Park-lane, W.

The paper read was—

SOME STATISTICS OF THE WORLD'S IRON AND STEEL INDUSTRIES.

By William Pollard Digby,
A.M.I.Mech.E., A.M.I.E.E.

"Iron is threatened"—Rt. Hon. Joseph Chamberlain, M.P., at Glasgow.

"He is not born, nor his father nor his grandfather, who will see the British iron trade displaced from its proud position . . . ."—Mr. Hugh Bell in the *Independent Review*, October, 1903.

The first of the above utterances has been discounted to a very large extent by Mr. Hugh Bell's trenchant article in the *Independent Review*. But Mr. Bell has presented the case from the broader view of the "threatened" British iron master. It is the object of the writer to present his investigations from—

1. The iron founder's standpoint in England and Germany in regard to the respective supplies of iron ore in the two countries, and their productions of pig iron as compared with the United States;

2. The statistical standpoint showing the extent of the external import and export trade of the United Kingdom relative to that of the external trade of other countries; and

3. The margin of profit of the iron industries reckoned on the external trade alone of the leading iron-producing countries.

In regard to all statistical investigations, the initial year of computation is one of the most vexed of questions. Comparisons of isolated years lend themselves to unscrupulous manipulation; on that account the figures of each year from the selected starting point will be given in the ensuing pages, and, as far as possible, the figures averaged over quinquennial periods. For the United Kingdom the writer decided wherever possible to start his computation from 1868. This allows of seven quinquennial periods of five years each, the last ending in 1902. To have started in 1873 would have been to start in a boom year when prices and the industry generally were inflated by reason of the Franco-Prussian War. To have started with 1871 and ended with 1900 would have excluded the last two years from computation. A start in 1878 to include only five quinquennial periods would scarcely have been legitimate, while a start in 1863, or earlier, would have been too remote for controversial value.

A complete survey of so vast an undertaking as the British iron trade, with its many ramifications, its complex questions, might well appal a Royal Commission, while an extension of the survey to the dissection of the exact situation in regard to every branch of the iron and steel industries of the United States and Germany would occupy a special International Commission for an indefinite period.

The difficulty likewise hinges upon the question of internal consumption, of what proportion the home market bears in each case to the country's export trade, and as to how far the imports from other countries affect the home market. The relation of the import and export trades to each other is easily defined, and the chief sections of the import and export trade receive separate enumeration in the various Government returns. While it is possible to

define the value, say, of steel rails, respectively imported and exported from the United Kingdom, we do not know the total production or the value of steel rails used in any year by the different railway companies and tramway undertakings within the kingdom. Again, it is possible to give the value in any year of the locomotives sent to foreign countries and to our own Colonies, and it is not difficult to enumerate the sporadic dumpings of locomotives into England on those occasions when lack of foresight had allowed the number of engines under construction to fall below immediate requirements, so that occasional purchases from America resulted. We can, in this latter case, go a step further and give the number of locomotives included in the rolling stock for any one year. But we cannot give the amount of the expenditure in any year on new locomotives either for our railways or for the rough lines laid by contractors for their dock, or reservoir, or railway, constructional work.

Similarly, if we regard shipping, while returns have of recent years been published giving the values of our sales of new ships built for foreign countries, we have no return of the value of the yearly additions to our mercantile marine, or of the value of the plates, rivets, or stern-frames which, forming the raw material for the shipyard, are nevertheless the finished product of the steel merchant. We are also without returns as to the value of the iron and steel supplied to the ship's engine builders wherein "the purring dynamos," the towering five-crank reciprocating engines, the compact turbines, the belauded Scotch and belittled Belleville boilers, find their raw material.

Turning to the textile or electric cable factories of Lancashire, or to the paper mills of the Thames Valley, no returns tell of the proportion of foreign machinery therein installed or of the extent to which the manufacturers of their myriad engines, boilers, looms, brading machines, potchers, shafting, or pulleys, have indented directly on foreign or on British machine makers, or have purchased high class machinery, itself in part made from raw iron or raw steel produced, perchance, in a foreign country.

So intricate and so st are the details of the home markets of the iron founder and of the engineering manufacturer, that the only elucidation of its extent, the only dissection of its veins and nervous system, wherefrom correct diagnoses are apparent to the intellect of even those who cursorily study statistics, is at present attainable. The simile of the physiology of the human system is capable of further consideration. We have the Protectionist school of doctors who, lacking material from which to diagnose the patient's internal condition, select evanescent excrescences upon which to enunciate theories respecting the way in which the virus of dumping is rendering our commerce atrophied. On the other side are the Free Trade Pundits who, also speaking on external evidence merely, regard the policy of free imports as providing stimulus and sustenance to our commerce as a whole.

In the old Moslem schools of medicine the dissection of the human body was anathema, and the obtaining by any Government department of statistics relating to the respective expenditures of factories on British and foreign raw materials, or as to the respective labour expenditures in preparing these raw materials for the markets, home, colonial, and foreign, differentiating between the markets, would provoke almost as much indignation as surgical research in Mahommedan orthodox circles.

Yet, for generation after generation the ascertaining of knowledge by any other than the experimental, kill-or-cure, methods with drugs was taboo. To experiment with the drug of tariff revision bids fair, until the conditions of the internal trade are clearly enunciated, to be as hap-hazard and as fatal, as were any of the practices of the old schools of medicine.

Pending, however, the ascertaining of the internal position of the British iron trade in its most delicate and important ramifications, it is possible to compare the foundations of the industry in the United Kingdom, Germany and the United States, so far as the production of iron ore and pig iron are concerned. It is also possible to measure in each case the extent of the respective import trade and export trade together with the margins between the trade margins which either cover imports of food or luxuries or necessitate margins which may have to be met by the export of other goods.

Production of Iron Ore.

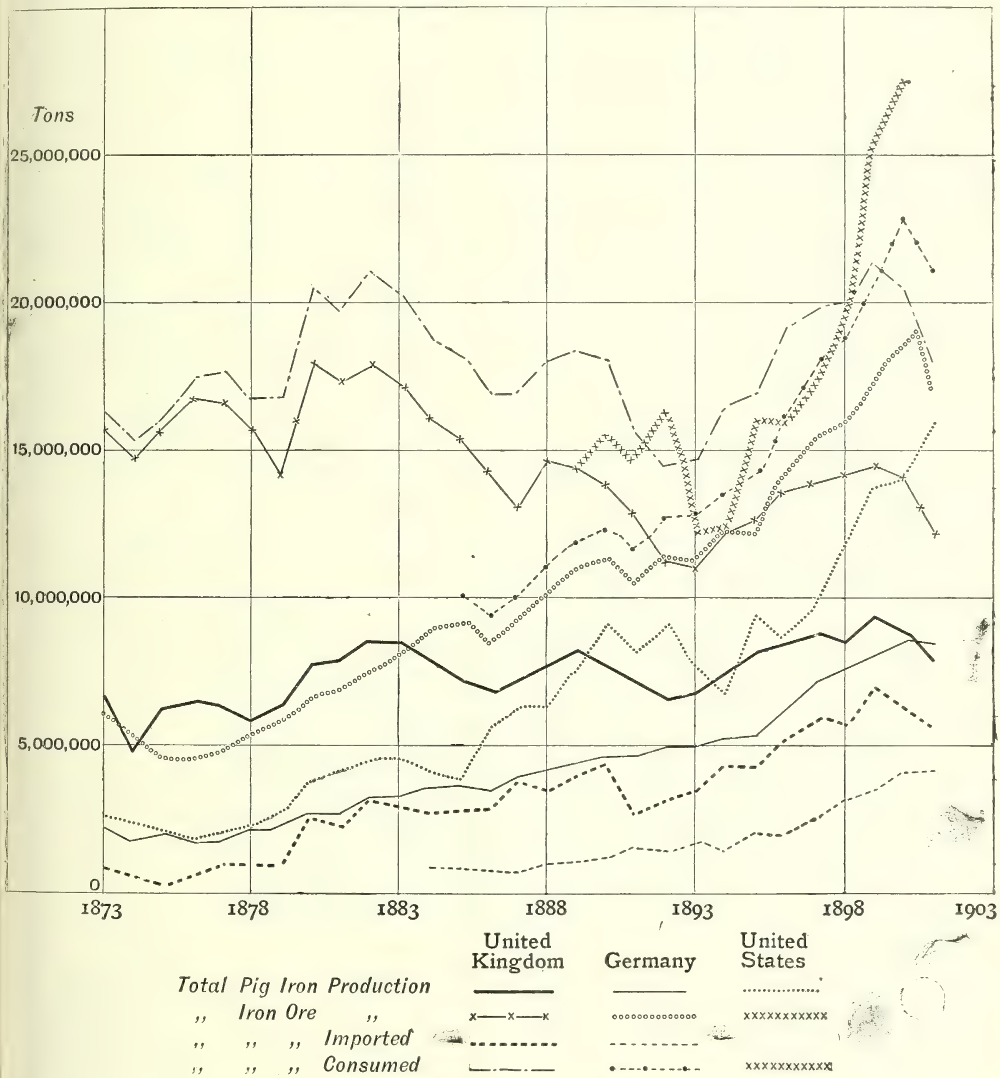
To go literally down to the bed rock of the iron industry is to commence with the production and consumption of iron ore. The statistical abstracts issued by the Board of Trade in a special Table, give the productions of iron ore in the leading ore-producing countries of the world. In other Tables are to be found the particulars of the imports of ore in the case of Great Britain from 1873, and, in the case of

Germany, merely as far back as 1885.* The United States are, apparently, non-importers of ore; therefore, in their case the consumption, only recorded since 1889, is reckoned at the recorded production, while in Great Britain and Germany the consumption is reckoned at the home production plus the importations. In Diagram I a set of seven curves show the figures for thirty years in regard to iron ore, and three other curves the pig iron production.

It will be noticed that England retained the lead as an ore-producing country until 1898, when the first available records in America are on a par with the declining British production. The German production of ore effectively surpassed that of the United Kingdom in 1896. In both cases the imports of ore are rising steadily. With regard to total consumption, that in the United States surpassed the British consumption in 1892, remaining below it until 1899. In 1901 the German consumption also exceeded the British, failing however to overtake the American consumption. The accompanying Table I. gives a quinquennial

AGRA I.

Productions of Iron Ore and Pig Iron.



*Although not shewn in the Statistical Abstracts issued by the Board of Trade, the United States does import ore. In 1902, the value of 1,165,000 tons imported, stood at over [illegible],583,000 dols.

analysis of the productions, imports, and consumptions. The great dependence of the British iron master on foreign ore, as contrasted with the position of his German *confrère*, are best illustrated by the proportional values of this Table. The gradual fall in British production as against an increasing British consumption betokens one of the British troubles, quennium, 28 and 15 per cent. respectively of the ore consumptions of England and Germany were obtained from other countries. In the last quinquennium the British consumption in 1893-1897 being taken as 100, the German ore imports stood at 24 as against the British figure 35.

Too great a reliance must not, however, be

TABLE I.—IRON ORE.

Productions, Imports, and Consumptions; average Tons, 000's omitted.

Quinquennial Period.	1873-77.	1878-82.	1883-87.	1888-92.	1893-97.	1898-1902.
United Kingdom—						
Production	15,956	16,722	15,227	13,402	12,735	13,673
Imports	800	2,125	3,078	3,805	4,867	6,135
Total consumption	16,756	18,847	18,305	17,207	17,602	19,808
Germany—						
Production	5,147	6,845	8,952	11,054	13,166	17,351*
Imports	—	—	716*	1,397	2,291	4,040*
Total consumption	—	—	9,525†	12,451	15,457	21,391*
United States—						
Production	—	—	—	15,360*	15,950	25,140‡*

Proportionate values putting the consumption of each country in 1893-97 as equal to 100.

Quinquennial Period.	1873-77.	1878-82.	1883-87.	1888-92.	1893-97.	1898-1902.
United Kingdom—						
Production	91	98	87	76	72	78
Imports	4	9	17	22	28	35
Total consumption	95	107	104	98	100	113
Germany—						
Production	41	55	58	71	85	112
Imports	..	..	4	9	15	25
Total consumption	41	55	62	80	100	137
United States—						
Production	..	..	..	97	100	157

Proportionate values for Germany and the United States putting the consumption of the United Kingdom in 1893–97 as equal to 100.

Quinquennial Period.	1873-77.	1878-82.	1883-87.	1888-92.	1893-97.	1898-1902.
Germany—						
Production	30	40	52	64	77	99
Imports	—	—	3	8	13	24
Total consumption	30	40	55	72	90	122
United States—						
Production	—	—	—	89	93	143

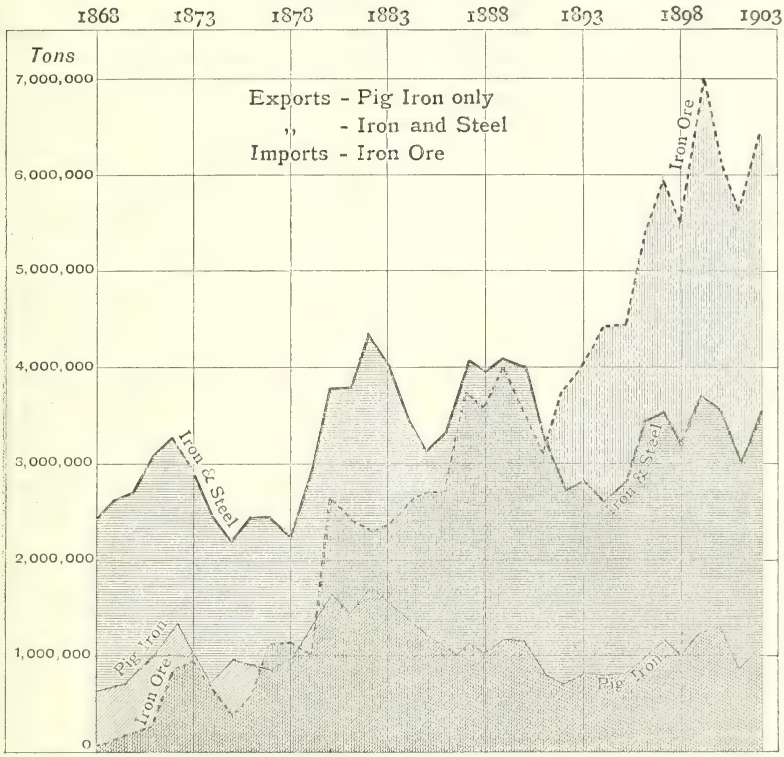
* Four years only. † Total average reckoned, 4 years plus imports, 3 years without, ÷ 5. ‡ 3 years only.

while the rapid development of the mineral resources of Germany and America have, respectively, been due to the development of local beds of their own iron ore. The proportionate values, however, serve to indicate the extent to which Germany and England have alike to look abroad for the raw material for their furnaces. Taking the 1893-97 quinplaced on figures of ore consumption. One group of furnaces may be using a locally mined ore, poor in iron, while another group may be dependent on sea-borne ores containing far higher percentages of iron. Again, certain local ores may lend themselves to one method of treatment only, while other beds have only

comparatively recently become capable of treatment in the blast furnaces.

As we are, therefore, ignorant of the value of the ore mined in each country, even at the place of production, and still less at the place of consumption, when the cost has been swollen by transport charges, and while we can only compute the value at the port of entry, comparisons of ore consumption should not be accepted as the only criteria the national position. Yet, for Great Britain, if it be conceded for a few moments that imports of line O.O.O. superimposed over the lines P.P.P. and S.S.S. shows the volume of ore imports. It will be noticed that in volume it first exceeded the volume of pig iron exported in 1877, and, rising by leaps and bounds, exceeded the total export tonnage in 1891. Even more striking are the figures of the succeeding Table II., whereby the growing dependence on foreign ore is shown to have risen from 12·4 tons to 70·7 tons of ore per 100 tons of pig iron produced. Under such circumstances the rise shown in the succeeding line, 78·2 to 544·0 tons

DIAGRAM 2.



foreign ore are a tax on the iron master, some significant factors which will govern his future may be enunciated. Before looking into the figures of values, a glance at diagram No. 2 will be of interest. Here volumes only are considered. The curve marked P.P. gives the tons of pig iron exported in the last thirty-five years, the curve marked S.S.S. shows the total volume of wrought iron and steel and pig iron exported. The margin between the tonnage of pig iron and that of the iron and steel exports indicates the tonnage of iron and steel manufactures other than pig iron. The dotted of ore imported per 100 tons of pig iron exported, will only evoke surprise at any country being able to export any pig iron at all under such conditions. For the purposes of illustration I have dealt with comparative tonnages, values however may be compared with equally startling results. The ratio of the cost of imported ore contrasted with the value of exported pig iron has risen from £26·2 per £100 to £130·8 per £100. Or, ignoring for the moment the value of exported pig iron, and contrasting the bill for imported ore with the value f.o.b. of manufactures of iron

TABLE II.

Quinquennium.	1873-77.	1878-82.	1883-87.	1888-92.	1893-97.	1898-1902.
Ratio tons of ore imported into the United Kingdom per 100 tons of pig iron produced	12·4	27·7	40·2	50·2	61·2	70·7
Ratio tons of ore imported into the United Kingdom per 100 tons of pig iron exported................	78·2	129·6	262·6	388·6	507·8	544·0
Ratio of expenditure on foreign ore in £ sterling per £100 value of exported pig iron	£26·2	51·2	103·2	113·2	149·0	130·8
Ratio of expenditure on foreign ore in £ sterling per £100 value of exported iron and steel goods other than pig iron, etc.	£4·41	8·24	10·05	11·66	17·44	20·89

TABLE III.—Pig Iron.

Production, Consumption, with Balance Imported or Exported. Annual Averages. Tons 000's omitted.

Balance excess of Production indicated +, excess Consumption indicated –.

Quinquennial Periods.	1873-77.	1878-82.	1883-87.	1888-92.	1893-97.	1898-1902.
United Kingdom—						
Production......................	6,416	7,265	7,665	7,668	7,913	8,720
Consumption....................	5,536	6,007	6,504	6,727	7,029	7,744
Balance	+ 880	+ 1,258	+ 1,161	+ 941	+ 984	+ 976
Germany—						
Production......................	1,991	2,680	3,622	4,620	5,417	8,041
Consumption....................	2,319	2,656	3,586	4,724	5,905	8,287*
Balance	– 428	+ 24	+ 36	– 104	– 488	– 69†
United States—						
Production......................	2,184	3,529	4,968	8,147	8,261	14,176
Consumption....................	2,445	3,961	5,249	7,834	7,839	13,643*
Balance	– 261	– 332	– 281	+ 313	+ 422	+ 122†

Proportionate Values, putting the consumption of each country in 1893–97 *as equal to* 100.

United Kingdom—						
Production......................	91	103	109	109	113	124
Consumption....................	79	85	93	97	100	111
Balance	+ 12	+ 18	+ 16	+ 13	+ 13	+ 13
Germany—						
Production......................	37	46	61	78	92	136
Consumption....................	41	46	61	80	100	140*
Balance	– 4	..	..	– 2	– 8	– 1†
United States—						
Production......................	28	45	63	104	105	182
Consumption....................	31	50	67	100	100	174*
Balance	– 3	– 5	– 4	+ 4	+ 5	+ 2†

Proportionate Values for Germany and the United States, putting the consumption of the United Kingdom 1893–97 *as equivalent to* 100.

Germany—						
Production......................	28	38	51	66	77	114
Consumption....................	33	38	51	67	82	118
Balance	– 5	—	—	– 1	– 5	– 1
United States—						
Production......................	31	50	71	116	117	202
Consumption....................	35	56	75	111	111	194*
Balance	– 4	– 6	– 5	+ 5	+ 6	+ 2†

* Four years only. † Balance reckoned on first four years only.

and steel goods other than pig iron, ships or their machinery, the ratio has risen from £4·41 to £20·89.

Small wonder that the investigator, stopping short at this point, should picture an industry under a crushing burden, an industry indeed threatened, not by the dumping of competitive manufacturers, but an industry crushed so far as expansion is concerned by the value of the dumped raw material which feeds its consuming furnaces.

I had said, conceding the point for a few moments, that these imports of ore are a tax on the iron-master. To those who consider all imports as inimical to a country's industrial welfare, it must be pointed out that this very inflow of ore, which is essential to the existence of our furnaces, is, in a measure, the income on British investments. Ore beds in Northern Spain have been purchased, railways built, and machinery supplied. Steam ship services have been organised, blast furnaces erected on the sea board, so that in some cases the ore is carried with only two handlings from the ship's hold to the furnace mouth. Those who talk loudly of extinction of the iron industry have not recked of the manner in which the iron industry has called, and not in vain, on the country's capital to provide other sources of raw material.

I have pointed out that iron ores differ radically in their richness and commercial value, and that their consumption is, by no means, an infallible index as to the position of a country's trade. With regard to pig iron our basis is a somewhat surer one, although the products of different districts vary slightly in constitution and value. Examining, therefore, Table III. which is compiled from the Board of Trade returns of pig iron production and consumption in different countries, we find, in the case of the United Kingdom, a growing consumption which has increased at a slightly greater rate than the growing production. The continued, and, for the last fifteen years, stable excess of production over consumption is exceedingly gratifying. It is to be noted that, in regard to Germany, matters are more in a state of parity for two of the six quinquennial periods for which figures are available. But, despite Germany's rapid growth as a producing country, the consumption has been in excess of the production albeit, latterly, by a small margin only.

With the United States the reverse is the case, the deficit of the first three quinquenniums being replaced by the surplus of the latter. This average surplus, be it noted, is, in the last period, one-eighth of the British average for that period. The relative growth (a persistent and enormous one for Germany and the States as compared with the persistent but small growth for the United Kingdom) is indicated by the Tables showing the proportionate values. Again, taking the consumption of the United Kingdom in 1893-97 as equal to 100, we find that the position in the United Kingdom from the 1873-77 period to that between 1891 and 1902 is represented by an increase in consumption from 79 to 111, while the production has increased from 91 to 124. Meanwhile, Germany has increased its consumption from 33 to 118, and its production from 28 to 114. With the United States the consumption has risen from 35 to 194, and the production from 31 to 202.

At this point it becomes impossible to trace further, with the detail desirable, the internal positions of the respective countries. We can, however, within certain limits, contrast the position of the export and import trades of England, Germany and America. Dealing first with the exports of iron and steel, the writer has been unable to define those of Germany and the United States earlier than 1879 and 1874 respectively. In the case of the United Kingdom, the following exports are embraced within the totals given:—Machinery and manufactures of iron and steel, but cycles, sewing machines, hardware, cutlery, telegraph wire implements and tools, ships and their machinery have been omitted. These omissions have been occasioned either by reason of their non-inclusion in earlier returns or by reason of their non-computation in the returns of the competing countries—the United States and Germany.

The German exports are, from 1884, embraced under the following headings:—Pig Iron, malleable bars, coarse wares, tin wares, iron wire, and machinery of all kinds. From 1879 to 1884 the only headings chronicled are pig iron, unwrought iron, railroad bars, and machinery of all kinds.

The exports from the United States are described as iron and steel, and manufactures thereof. Sewing machines are included from 1885, but not prior to that date.

It is quite probable that the classifications omitted from the British total, such as cutlery or hardware, are contained in the returns quoted of the other countries, but, lacking definite information on this matter, the writer has considered it safest to omit them from the British totals.

TABLE IV.—ANNUAL EXPORTS, £'s 000's omitted.

Year.	United Kingdom.	United States.	Germany.	Year.	United Kingdom.	United States.	Germany.
1868	22,561	—	—	1886	33,123	3,149	10,360
1869	27,653	—	—	1887	36,921	3,192	10,159
1870	29,522	—	—	1888	40,150	3,554	12,648
1871	34,096	—	—	1889	44,949	4,231	13,547
1872	44,416	—	—	1890	48,236	5,108	13,448
1873	48,311	—	—	1891	42,862	5,782	14,157
1874	41,609	2,578	—	1892	35,731	6,021	12,245
1875	35,639	3,281	—	1893	34,607	6,988	13,854
1876	28,652	2,618	—	1894	32,681	5,844	14,427
1877	27,607	2,893	—	1895	34,593	6,400	16,584
1878	26,573	2,694	—	1896	40,721	8,232	18,785
1879	27,511	2,613	3,426	1897	40,866	11,500	19,272
1880	39,019	2,140	6,866	1898	41,280	14,081	22,434
1881	39,055	2,853	7,465	1899	48,207	21,138	25,892
1882	45,462	3,510	10,513	1900	51,125	25,927	29,416
1883	42,482	3,833	10,741	1901	42,617	—	—
1884	38,829	3,674	12,839	1902	47,094	—	—
1885	33,930	3,518	10,551				

EXPORTS.

Quinquennial Averages. £'s 000's omitted.

Period.	1868-72.	1873-77.	1878-82.	1883-87.	1888-92.	1893-97.	1898-1902.
United Kingdom	31,650	36,364	35,524	37,057	41,987	36,694	46,065
United States	—	2,917*	2,662	3,473	4,939	7,793	20,352*
Germany	—	—	7,067†	10,930	13,209	16,584	25,914*

* Three years only. † Four years only.

Proportionate values, putting those of each country in 1893-97 *as equivalent to* 100.

United Kingdom	86	99	97	101	114	100	125
United States	—	37	34	44	63	100	262
Germany	—	—	43	66	79	100	156

Proportionate values, putting those of United Kingdom in 1893-97 *as equivalent to* 100.

United Kingdom	86	99	97	101	114	100	125
United States	—	8	7	9	13	22	55
Germany	—	—	19	29	36	45	70

While the figures of individual years are of interest, their citation for the purposes of diagnosis or fiscal argument is, it may be again urged, absolutely valueless. For instance, one school of economists, counting from 1871, could claim an increase in export values of approximately £13,000,000 sterling, while the rival school, starting from the very next year, would point out that the increase was but £2,500,000. Similarly starting from 1879, one might claim that in twenty-three years the export values had risen by £19,500,000, while, starting from 1880, it might, with equal justice, be declared that the increase was only £8,000,000.

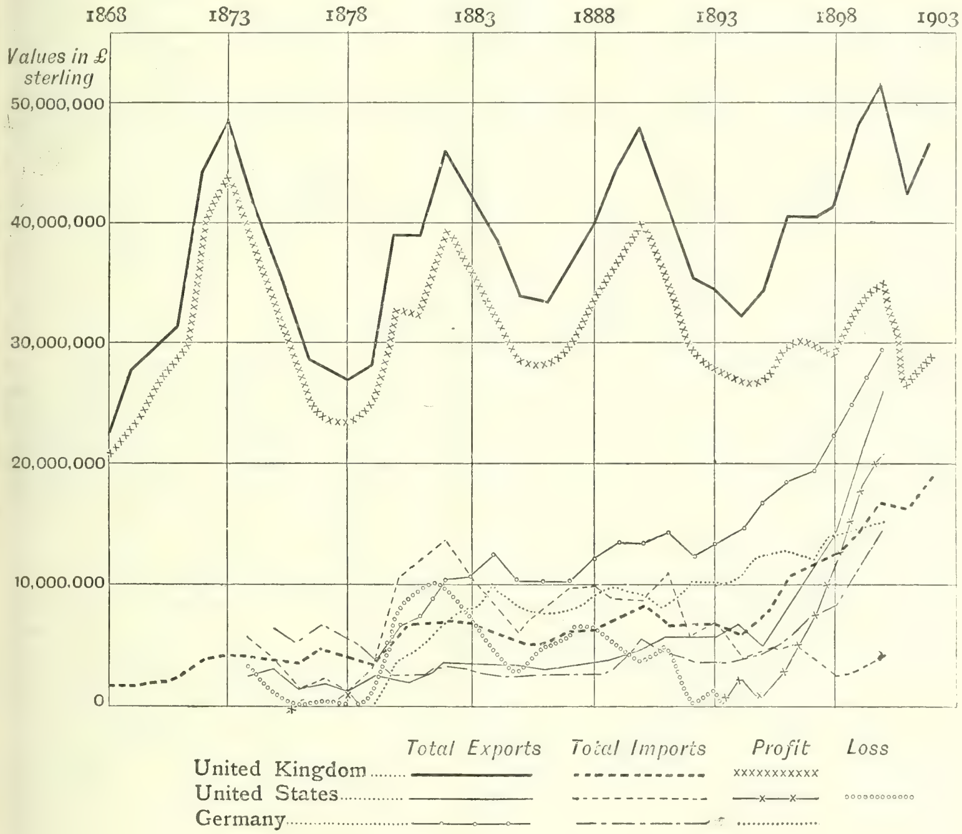
The only legitimate basis which tends to exclude a partizan presentment of the case is that of taking quinquennial periods. Examining the British averages, the wide margins of neighbouring years are found to be toned

lown, and the average exports during the atest quinquennium under review shown to be ıt a higher figure than ever before.

An examination of the American figures 'eveals an export trade, smaller in volume, but ɔersistently rising, until it has reached an ıverage nearly half that of Great Britain. The nargins between any two successive years were not, until latterly, so large as those ɔetween successive years in England. The 1868-72 to 1898-1902 has been from 86 to 125, while from 1874-78 to 1898-1900 the proportionate American rise has been from 8 to 55 and the German from 1879-82 to 1898-1900 has been from 19 to 70.

Having shewn that the figures from the Blue-books prove that the British export trade is, all things being considered, in a fairly satisfactory condition, inasmuch as in value it is equal to that of Germany and the United States together, we have now to turn to the question of imports.

DIAGRAM 3.



German exports, initially recorded as greater n value than those of the United States, have isen persistently, keeping, however, well ahead of the American until the last few years, when he rapidity of increase of the Trans-Atlantic competitor has given strong indication that he second place in volume among the world's ron and steel exporting countries will not long ɔe the boast of a continental country.

Taking the British average annual value ɔetween 1893 and 1897 as 100, the respective ɔroportionate rates of advance are best shewn ɔy the fact that the British rise in value from

Those of the United Kingdom have, it must be remembered, been saddled with the increasing volume of the iron ore brought from Spain and Sweden, from the very commencement of the period under examination, while, with regard to the German figures, the imports do not include iron ore prior to 1885. Further, it must be borne in mind that no imports of ore are recorded for inclusion in the United States imports.

Examining each country separately it will be

TABLE V.—ANNUAL IMPORTS, £'s 000's omitted.

Year.	United Kingdom.	United States.	Germany.	Year.	United Kingdom.	United States.	Germany.
1868	1,426	—	—	1886	5,052	7,507	1,707
1869	1,436	—	—	1887	6,219	9,840	1,975
1870	1,743	—	—	1888	6,492	9,800	2,502
1871	2,144	—	—	1889	7,547	8,476	3,388
1872	3,828	—	—	1890	8,119	8,336	5,719
1873	4,143	—	—	1891	6,860	10,709	4,376
1874	4,071	5,804	—	1892	6,783	5,783	3,967
1875	3,874	4,304	6,215	1893	6,650	7,198	3,724
1876	3,316	2,615	4,754	1894	5,949	4,195	4,146
1877	4,810	3,280	5,892	1895	7,403	4,610	4,303
1878	3,891	1,758	4,838	1896	10,582	5,068	5,782
1879	3,650	3,198	3,705	1897	11,610	3,220	7,327
1880	6,430	10,311	2,779	1898	12,463	2,525	8,093
1881	7,054	12,121	2,838	1899	14,733	3,160	11,428
1882	6,934	13,595	3,185	1900	16,456	4,090	14,268
1883	6,858	11,700	3,078	1901	16,023	—	—
1884	5,974	8,029	2,400	1902	18,529	—	—
1885	5,539	6,723	2,133				

IMPORTS.

Quinquennial Averages. £'s 000's omitted.

Period.	1868-72.	1873-77.	1878-82.	1883-87.	1888-92.	1893-97.	1897-1902.
United Kingdom	2,944	4,043	5,672	5,928	7,144	8,049	15,641
United States	—	4,226*	8,197	8,560	8,621	4,858	3,258†
Germany	—	5,620†	3,469	2,259	3,990	4,384	11,263†

* Four years only. † Three years only.

Proportionate Values, putting those in each country in 1893-97 as equivalent to 100.

United Kingdom	36	50	70	73	90	100	194
United States	—	87	168	176	177	100	67
Germany	—	127	79	51	91	100	280

Proportionate Values, putting those of the United Kingdom in 1893-97 as equivalent to 100.

United Kingdom	36	50	70	73	90	100	194
United States	—	52	101	106	107	60	40
Germany	—	62	43	28	49	54	140

noticed that, measured from start to finish, the figures of the United Kingdom show a rise which may well give cause for thought. The value of the imports of the United Kingdom is now in excess of the value of the imports of Germany and America together, while the American imports, which remained fairly constant from 1878 to 1892, have since rapidly fallen. On the other hand Germany has, with slight reactions, had a steady increase of imports since 1886. Thus, were the writer to fall back on the reprehensible policy of comparing single years, he might, starting from that date, declare that the German imports had increased eighty-fold in twenty-four years, whereas the British imports had only been three-fold.

Again and again the writer feels compelled to protest against the selection of single years for comparative purposes. Therefore, once more falling back on the system of quinquennial averages and proportionate values, and then

TABLE VI.—PROFITS. £'s 000's omitted.

Year.	United Kingdom.	United States.	Germany.	Year.	United Kingdom.	United States.	Germany.
1868	21,135	—	—	1886	28,391	– 3,205	8,653
1869	26,217	—	—	1887	30,702	– 6,648	8,384
1870	27,179	—	—	1888	33,568	– 6,246	10,146
1871	31,952	—	—	1889	37,402	– 4,245	10,159
1872	40,588	—	—	1890	40,117	– 3,228	8,062
1873	44,168	—	—	1891	36,002	– 4,927	9,781
1874	37,538	– 3,226	—	1892	22,948	239	8,278
1875	31,765	– 1,023	—	1893	27,957	– 960	10,130
1876	25,336	3	—	1894	26,732	1,659	10,281
1877	22,797	– 387	—	1895	27,190	1,790	12,281
1878	22,862	836	—	1896	30,139	3,165	13,003
1879	23,861	– 585	– 279	1897	29,256	8,281	11,943
1880	32,589	– 8,171	4,187	1898	29,817	11,576	14,341
1881	32,001	– 9,468	4,627	1899	33,474	15,938	11,428
1882	38,508	– 10,085	7,328	1900	34,669	21,084	14,268
1883	35,624	– 7,867	7,663	1901	25,594	—	—
1884	32,855	– 4,305	10,439	1902	28,565	—	—
1885	28,391	– 3,205	8,418				

PROFITS.

Quinquennial Averages. £'s 000's omitted.

Period.	1868–72.	1873–77.	1878–82.	1883–87.	1888–92.	1893–97.	1898–1903.
Jnited Kingdom	33,414	32,321	25,960	31,125	35,225	28,255	30,224
Jnited States	—	– 1,415†	– 5,535†	– 5,087	– 3,682	2,935	17,124*
iermany................	—	—	3,966†	8,671	9,219	12,200	14,651*

* Three years only. † Four years only.

Proportionate Values, putting those of each country in 1893–97 *as equivalent to* 100.

Jnited Kingdom	117	114	91	110	125	100	107
Jnited States	—	– 47	– 181	– 173	– 125	+ 100	+ 583
iermany................	—	—	32	71	75	100	120

Proportionate Values, putting those of the United Kingdom in 1893–97 *as equivalent to* 100.

Jnited Kingdom	117	114	91	91	125	100	107
Jnited States	—	– 5	– 19	– 18	– 13	10	59
iermany................	—	—	14	30	33	43	52

aking as the basis the years 1893-97 in Great 3ritain as equal to 100, we find that the British mports have risen without setback from 36 to 94. Meanwhile the American figures, after ising to 107 in 1888-92, have fallen away to o. The German values, on the other hand, ifter falling to 28, have since risen to 140.

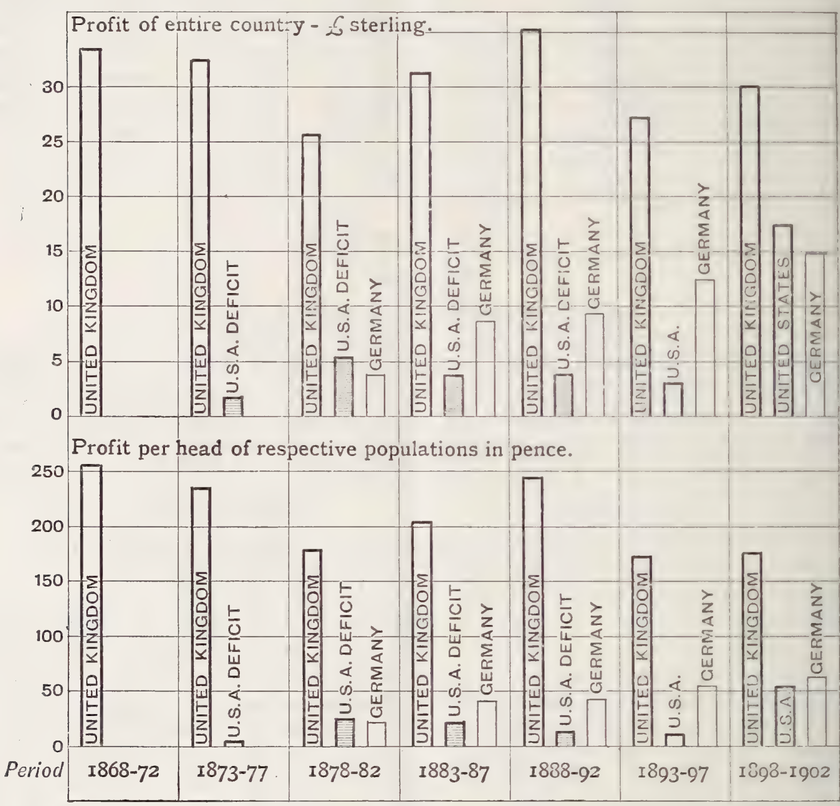
So far as the tremendous British rise is oncerned, while all imports have to be eckoned as on the debit side when one onceives John Bull, ironmaster (otherwise Department X, The United Kingdom, Ltd. merchants and manufacturers) as a single branch of the country's industries, these imports, one third of which are occasioned by iron ore (which all economists would concede to be a raw material), also contain scrap iron for remelting, pig and puddled iron, unwrought steel plates, rivets, all of them items classed as manufactured or partly manufactured, but as surely the raw material of other industries as is crude ore to the iron founder.

While we cannot, with any certainty, state the extent to which these imports have, by

ensuring cheap production, assisted (in the case of Great Britain) in the growth of our steadily expanding export trade, we can prepare balance-sheets as to the state of affairs in each country in each year. To the credit side all exports are reckoned which are embraced in the export returns of the countries under consideration, while to the debit are placed the ascertained imports. An excess of exports is reckoned as profit. That is to say, the margin by which the exports of the products of any particular industry exceeds the imports in that industry represents the profit or balance by which the excess margin is available for exchange against imports of food or luxuries. Similarly, an excess of imports, so far as that particular branch of industry goes which necessitates the exports of other mauufactures or food stuffs is treated as a loss—a loss not of an Australasian Colonial Premier's "golden sovereigns" but of produce or service rendered which another department of a country's commerce or industry makes good.

Examining Table VI. in detail, the tempt[...] tion to quote individual years again obtrud[...] itself. It is the best to point out that whi[...] the United Kingdom has made gigantic pr[...] fits, the United States only permanently becan[...] a profit-making country in 1895, while Germa[...] appears to have made a profit from 1880. [...] regard to the States, a change from an avera[...] deficit of over £3,500,000 sterling in one qui[...] quennium to a profit of nearly £3,000,000 [...] the next, and over £17,000,000 in the third, i[...] probably without parallel in the world's indus[...] trial history. Had the Bureau of Statistics a[...] Washington ascertained, and had our Boar[...] of Trade published, each year, the output c[...] machinery, of steel rails, of steam engines i[...] the forty odd States of the Union, had we ha[...] similar indications in Great Britain, then indeed, had we been saved panics concernin[...] Steel Trust, and the incredible value of th[...] mineral wealth of North America would no[...] have burst like a revelation of doom on manu[...] facturing England.

DIAGRAM 4.



Returning to the kernel of Table VI., namely, the proportionate average values in each quinquennium, those of Great Britain between 1893-97 being again taken as equal to 100, we find that the comparative value of the British profit has only once fallen below par, but standing at 107, is at a figure which has been four times exceeded. Meanwhile, the United States, which first showed a profit value of 10 in the 1893-97 quinquennium, now stands at 59, and Germany, whose profit has uninterruptedly risen, now has a profit value of 52. The figures for each year shown in Tables IV., V., and VI. are depicted graphically in Diagram 4 (upper half).

The British diminution of profit occasioned by exhaustions of ore and increase of imports deals only with an apparent currency loss so far as the entire country is concerned. In the case of the United Kingdom it is possible to compute the extent to which the fall in profit, as measured in currency, has been neutralised by the fall in prices.

Assuming that the profit margins already computed had in each case been exchanged against food, it would be possible to calculate the relative value of the profit measured in food. This relative coefficient of food profit becomes a factor of the greatest value, for by it alone can be ascertained the relative position of the country as a whole with regard to the monner in which its surplus manufactures help to feed its population.

The writer ascertains this relative co-efficient of food profit for any quinquennium by dividing the proportionate profit value of any quinquennium by the average value of Mr. Sauerbeck's index values for food for that quinquennium.

This gives the following Table:—

UNITED KINGDOM.

Quinquennial period.	Proportionate value of profit in quinquennium (the 1893-97 period being reckoned as equal to 100).	Average of the Sauerbeck food index price.	"Coefficient of food profit" value expressed in ratio of food obtainable.
	a	b	$\frac{a}{b}$
1868-72	117	99	1·177
1873-77	114	102	1·117
1878-82	91	92	0·990
1883-87	110	73	1·507
1888-92	125	74	1·689
1893-97	100	66	1·501
1897-1902	107	67	1·596

These figures show that, taking the nation as a whole, the maximum of profit, when allowance is made for food value, was not in the early seventies, the era which has been so often cited as that of the zenith of free trade prosperity, but between 1888 and 1892. Above all should it be remembered that the quinquennium just ended shows, with one exception, the highest co-efficient of food profit. Of course, the criticism may be advanced that while this co-efficient of food profit has advanced, the population of the country has advanced at an even greater rate. But, before dealing with this particular phase of the case, that of the question of the profits per head of population in the United Kingdom, the United States, and Germany needs to be considered.

This has been done, and the results are shown in Table VII. It is apparent—at first almost alarmingly apparent—that the British profits per head of population have tremendously fallen, and now stand at a figure 50 per cent. less than that obtained in the first quinquennium quoted. On the other hand, it must be remembered that the profit margin per head of population in the United Kingdom stands at more than three fold that recorded for the United States, and almost three fold that recorded for Germany.

In Diagram 4 the respective profits for country as a whole and also per head of population are depicted.

Expressed in percentages, the British profit per head of population in 1897 being taken as equal to 100, we note that in the last period under consideration the British profit stood at 102, while the American and German respectively stood at 31 and 36. Owing, however, to the great increase in population (nearly 30 per cent. in thirty years) in the United Kingdom, it is not surprising to observe that the relative value in the first of the quinquenniums stood at 149, a figure which the growth of imports, particularly those of ore, have prevented our since obtaining.

But, so far as comparisons of widely separated periods are concerned, mere currency profits, expressed in monetary tokens of exchange, are not comparisons which truly represent the state of affairs. Instead, we have to fall back on the factor, which I have ventured to call the "coefficient of food profit," and which I have calculated for the United Kingdom as a whole.

Expressed, therefore, per head of population we have the following Table:—

UNITED KINGDOM.

Quinquennial period.	Proportionate value of profit per head of population in quinquennium (the 1893-97 period being reckoned as equal to 100).	Average of the Sauerbeck food index price.	"Co-efficient of food profit" per head of population, or profit value expressed in ratio of food obtainable.
	a	b	a/b
1868-72	149	99	1·505
1873-77	137	102	1·343
1878-82	104	92	1·130
1883-87	109	73	1·493
1888-92	141	74	1·905
1893-97	100	66	1·515
1898-1902	102	67	1·522

This Table and the Table shewing the pro for the entire country are plotted together Diagram 5. The currency profits per he of population and for the entire count are expressed in percentages of the avera for the 1893-97 quinquennium, and the Sau beck index price for food is also expressed the average percentage for each quinquenniu the average in the eleven years ending 18 being taken as equal to 100. The national a individual coefficients of food profit are she on a somewhat distorted scale (zero formi the base line on the percentage scale, a 0·800 on the co-efficient of food profit scal in order to emphasize the fact that despi falls in profit measured in currency, the prof both national and individual, measured in t purchasing power of that currency profit co

TABLE VII.—IRON AND STEEL INDUSTRIES.

Profits per Head of Population.

Quinquennial Period.	1868–72.	1873–77.	1878–82.	1883–87.	1888–92.	1893–97.	1898–190
United Kingdom—							
Average annual profit, £000's omitted	33,414	32,321	25,960	31,125	35,225	28,255	30,224
Population, in middle year of quinquennium, £000's omitted	31,205	32,749	34,623	36,331	37,485	39,265	41,164
Average profit per head of population in pence........................	257·3	236·9	179·9	205·6	244·2	172·6	176·2
United States—							
Average annual profit or loss, £000's omitted	—	−1,415	−5,535	−5,087	−3,682	2,935	17,124
Population, approximate, in middle year of quinquennium, 000's omitted	38,558	44,300	50,156	56,500	62,622	69,000	76,303
Average profit or loss per head of population in pence	—	−7·6	−26·4	−21·6	−14·1	10·2	53·8
Germany—							
Average annual profit, £000's omitted	—	—	3,966	8,671	9,219	12,200	14,651
Population, approximate, in middle year of quinquennium, 000's omitted	—	—	45,234	47,300	49,428	52,800	56,367
Average profit per head of population in pence........................	—	—	21·4	43·9	44·3	55·4	62·3

Proportionate Values of Profit per Head of Population, the figures for 1893-97 *being in each case taken as equal to* 100.

United Kingdom....................	149	137	104	109	141	100	102
United States	—	−74	−258	−211	−138	100	527
Germany	—	—	38	79	80	100	112

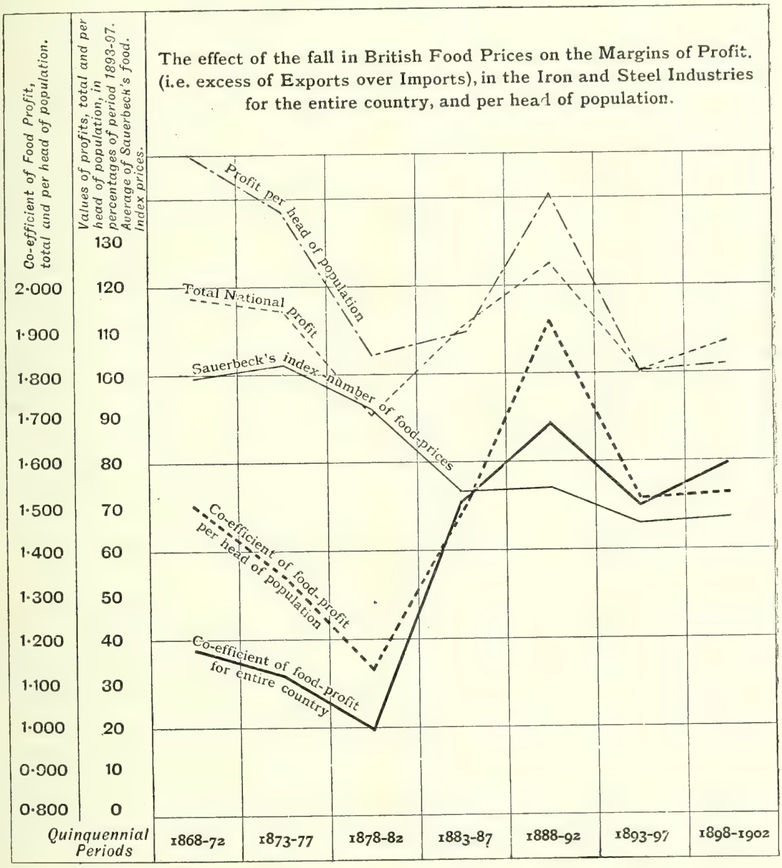
Proportionate Values of Profit per Head of Population, the British figures for 1893-97 *being taken as equal to* 100.

United Kingdom....................	149	137	104	109	141	100	102
United States	—	−4	−15	−12	−8	+5	+31
Germany	—	—	12	25	25	32	36

ted in food, has risen in a marked degree, compared with the second and third quinenniums, but has fallen as compared with e fifth quinquennium, the period in which, easured either by exports or gross profit, or ofit, or profit per head of population, or coficient of food profit, the state of the external ıde of the United Kingdom was the most ›urishing.

The writer has omitted a consideration of to discuss the facts wholly dispassionately, the temptation to ignore these imports, inasmuch as they are the return on British capital invested abroad, would have led him to substitute other Tables than those presented concerning the various possible computations of profit. Had it not been for a desire to present facts without partiality or bias, the writer, looking from the point of view of one school, would have stopped short of showing how

DIAGRAM 5.



ıe directions or composition of the export ·ade in his desire in this article to present nly the situation in relation to the broad round of the margins between the values of ıe export and import trades of the United Kingdom, the United States, and Germany. The relation of iron ore imports to the export ·ade into the United Kingdom has been dealt ith at length because of its importance in elation to our whole import trade, an importnce which has not often been recognised. Had it not been for the writer's earnest desire largely the fall in currency profit was neutralised by the fall in food prices, or looking from the point of view of the other school, he might in a pæan that all was well have latterly included the value of shipping built for foreign owners, a factor of £10,000,000 sterling. Absolute impartiality can only be found in the pages of a Blue-book, and then only by considering the contents of many pages. The common saying that statistics will prove anything is certainly incorrect; none the less single columns of figures taken out of

their proper context and paraded without the other columns (which also bear on the subject) may be adduced as an attempt to prove any particular view, such isolated columns selected having depended only on the peculiar outlook of the individual writer.

Whether our studies of industrial economics will on one hand continue to be as full and as complete as the wit of man and the Board of Trade rerurns can make them, or on the other hand be limited to surmises based on the condition of the external trade (simply and solely because we have no records of the quantities and values of our manufactures which are internally consumed) rests with the manufacturers of this country. Any person can prate of exports and imports, but who can speak even in regard to iron, of the employment given to thousands of artisans making looms for Lancashire, locomotives and rails for our railways, dynamos and arc lamps for our street lighting, steel girders and angle iron for our large buildings? Or, again, as regards the value of the shipping added each year to our mercantile marine; while it would not pass the wit of Dr. Ginsburg to estimate the capitalised value of the shipping on Lloyd's Register, even he might fight shy of estimating the apportionment of the expenditure of a single year's increase among the many industries whose concerted efforts have fed the ship builder. Yet large quantities of our food imports are paid for by new ships made to foreign order, other quantities of food are paid for by old ships sold for a few more years of life or to be broken up, while still other quantities of the imports which enter the country are the earnings of ships carring the red ensign and launched in the preceding year.

A great volume of our iron must surely go into what, for varying periods, are investments which are directly or indirectly remunerative, railways, shipping, locomotives, lathes, looms, or other machinery; even the hammer and cold chisel are not unproductive directions either for home manufactures or imports.

"Among the blind, the one-eyed is King." What shall we say of John Bull, who is not even equipped with half his powers of vision when considering his own entire commerce? External commerce is clearly displayed in export and import returns. Internal commerce is practically shut off from his vision. Its fruits, so far as percentage of pauperism or savings bank returns are concerned, can be gauged any day. But the full extent of the effects of "dumping" can only be truly known when manufacturers will consent to a dissect[ion] of the statistics, not only of the trade of ma[nu]facturer A whose finished article is threate[ned] by foreign competition, but also by a dissect[ion] of the trade of manufacturer B whose r[aw] material is often the finished product [of] manufacturer A.

The writer has conversed or correspond[ed] with many engineering manufacturers. [B]ut not one even has been able to give him [any] figures for any year in regard to unsuccess[ful] tenders of the respective number of times a[nd] respective percentage margin by which co[m]peting English and competing continen[tal] manufacturers took work for which he h[ad] quoted.

At a time when ill-digested statistics [are] thrown to and fro in argument, a plea [for] more statistics sounds impertinent. [Yet] some measure of the relation of impo[rts] not alone to exports, but to home consumpt[ion] also, is surely necessary before we talk [of] doomed industries. Will none cease from [the] strife of the rival panaceas—protection, alte[red] business methods, temperance, retaliati[on], education, free labour, bounties, and so fo[rth] (good though some of these may be) and ur[ge] to obtain the true figures of internal trade a[nd] its relation to exports and imports? For, o[nly] when these have been obtained are the co[m]ponent parts available with which alone it [is] possible to paint the only veracious picture [of] the nation's true condition.

DISCUSSION.

Mr. Moreton Frewen, in opening the discussi[on], said he was afraid it would be impossible to criti[cise] effectually such a paper as Mr. Digby's, in the cou[rse] of a few minutes. He was not altogether in sympa[thy] with the general argument of the paper. Quot[ing] from memory, he believed that in 1880 we, in [this] country, were producing three times as much pig ir[on] as Germany, and twice as much as the United Sta[tes], but last year both those countries had far outstrip[ped] us. Although this was scarcely the time to enla[rge] upon the general aspect of the fiscal question, [he] did not think the reader of the paper had pro[ved] his argument that our steel and iron industries w[ere] on a satisfactory basis. He thought on the wh[ole] the view that the internal trade of our country, wh[ich] could not be judged from the export and imp[ort] returns, was on a sound and satisfactory basis [as] compared with protectionist countries was scarc[ely] borne out by the figures. Although reluctant [to] press protectionist views upon the audience, he wis[hed] to say, having been brought in contact with [the] French school of political economists, who for [the] most part were protectionists, that the conditi[on]

France were very striking. France had been a trade country for a long time, but had been ing its tariff duties on all sorts of things for the fifty years. Mr. W. J. Harris had written very admirable paper which appeared in the ournal of Statistical Society" for 1894, wherein showed that in 1846 the wealth of France ided by the population was only £93 per d, while fifty years afterwards it had risen to 54; whereas our per head wealth was £205, and l only gone up to £248. So that France, not-hstanding an enormously expensive war and the s of two provinces, had far outstripped in the race for wealth, and had reversed condition of low tariffs which had controlled her nces.

Mr. BENNETT BROUGH thought every one in the om would agree that more detailed statistics on subject of iron and steel industries were desirable. thought the year 1868, which Mr. Digby had osen for computing his statistics, was peculiarly propriate in that room, because it was in 1868 that Society of Arts began to realise the necessity for voting more special attention to iron and steel, and ps were then taken to found the Iron and Steel stitute, and the first meeting of that Institute was held the Society of Arts in 1869, under the Chairman-p of the Duke of Devonshire. That connection h the iron and steel industries had always been intained. Mr. Digby, at the beginning of his per, said that the United States were non-importers ore. Well, on referring to Mr. Swank's figures blished by the United States Government, he ind that the United States at the present time re importing over a million tons every year princi-lly from Canada, Newfoundland, and Cuba. gain, in another portion of the paper Mr. Digby d that we were ignorant of the value of the ore ned in different countries. He (the speaker) had en evidence some years ago before a Home Office mmittee on mineral statistics, which was presided er by the late Sir Clement Le Neve Foster, and outcome of the work of that committee was that Home Office published every year a detailed mparative report giving the mineral production of ery country in the world, and in these reports value of the ores mined were set forth. any of the statistics that appeared in the news-pers were misleading, particularly for the reason at the value was apt to be omitted. For example, amount of the annual coal production for United States in 1901 was 266,000,000 tons, d for this country it was 222,000,000 tons. it the values of this output were respectively the larger amount produced in the United ates £69,000,000, and for that in this country 102,000,000, so that the apparent excess of produc-n was not real, because a lot of the coal that was oduced in the United States was a lignite of very or quality, whereas absolutely no lignite was produced in this country. Confusion, too, was sometimes caused by the difference between the American ton of 2,000lb. and the British statute ton of 2,240lb. Mr. Digby stated in his paper that the production of German ore was greater than that of English, but on referring to the late Sir Clement Le Neve Foster's figures he found that the production of iron ore in Germany in 1901 was 12,115,000 tons, and the production of this country was not smaller but, if anything, a little larger, viz., 12,472,000 tons. The value of those two items were, for Germany, £3,129,000, and for Great Britain, £3,222,000, so that the advantage was not so great as might appear from the published statistics. Mr. Digby had given them most valuable figures of the imports and exports, but with regard to production he had not quite realised the great value of iron and steel statistics collected by the British Iron Trade Association of this country and in America by the American Iron Association.

Mr. S. ROSENBAUM, while congratulating the reader of the paper on the able manner in which he had dealt with a most difficult subject said, he could not help demurring to some of the methods he had used. In the first place he (the speaker) objected strongly to being confined to Board of Trade and Government figures. There were the figures published by the British Iron Trade Association and the American Iron Trade Association, and in many respects he considered these more valuable and more reliable than those published by the Board of Trade. An instance of that could be seen in the monthly returns published of the tinplate mills in South Wales. From the returns it appeared that the tinplate mills had been increasing in number during the last few years. He was told that the Board of Trade returns included the galvanised tin makers, so that as a matter of fact the number of tinplate workers in South Wales, was less by about 100 or 150 than the number in the return. Facts of that kind made people sceptical as to the value of the Board of Trade returns. Another point to which he wished to take exception, was the definition of profits Mr. Digby had adopted as the basis of some very remarkable calculations. If we were to take excess of imports over exports as an index of the profitable character of trade, then we should be justified in agreeing with Mr. Chamberlain that the total exports of this country being much less than the total imports was a sign of increasing decadence in British industry. He was also sorry that the author had not gone into the question of internal trade. He believed that it was quite possible to make an estimate of the home trade. Such an estimate had in fact been made by Mr. Hugh Bell and by the Secretary of the Iron Trade Association. The iron and steel industry represented something like £130,000 or £140,000 per annum; and if they compared the total export trade of the country with the output value, he thought they would agree that in no country in the world did the pro-

portion of exports to total production bear so large a proportion as it did in this country; therefore the export trade was far more vital to this country than it was to the United States or to Germany, or to any other country; simply because in those countries the development of the iron trade came later, and they had a larger and more secure home trade. He totally disagreed with the idea that the comparison of ore production in different countries was any guide whatever to the state of the industry in those countries. This country was not the only one which imported ore or which produced ore. Germany mined an enormous quantity, and imported largely also. Then again, you could not compare the quantities of ore imported. You could not compare the ore found in Lancashire with that found in the Lake Superior district. From the one you could obtain 65 per cent., while from the other, only 20 per cent. It was much fairer to compare the pig iron production, because there you had eliminated the waste parts of the ore, and if you did make that comparison you would find this country had progressed at a much slower rate than any other country, and that now the total production of Germany and the United States were greater than in this country. He did not know whether that was a portent to be ignored. A point to which he wished to call attention, was that Mr. Digby used Sauerbeck's index number for making an ingenious comparison. He (the speaker) suggested it was unfair to use those numbers because they were unweighted and might lead to very different conclusions. He thought Mr. Digby would have been better advised in this instance if he had used the Board of Trade index number, especially as he was so fond of Board of Trade statistics.

Mr. T. NORDENFELT said the paper had been worked out with so much care and ingenuity and contained so many and important points that it would take weeks to study properly, and certainly a very long time to answer satisfactorily. One important point that the author had kept in view was his anxiety to get not only accurate figures, but to get them as detailed as possible. In his (the speaker's) country (Sweden) they were pretty well off in that respect, for they had an Ironmasters' Association which was an important institution, and which paid not only for research work but also for statistics. But even then they had not quite as much detail as they required, and without the details he did not see how anyone could do anything but guess and estimate. That, of course, was a very dangerous thing when dealing with statistics. Mr. Digby was quite right when he said he did not regard the import of partly manufactured material as a tax upon the earnings. Many years ago in Sweden they imported aliens from the East of Belgium, and then they imported Lancashire people who taught them better, and all their iron was sent over to England, and was used either for making steel or for blacksmith's work, but he did not consider that any way a tax upon the English manufactu because England could not produce the i herself. Much the same thing happened w regard to other raw materials. For examp we did not grow cotton and wool, and therefore became necessary to import them. The paper v one which required time to digest, but it v extremely important to have our attention drawn these statistics.

Mr. DIGBY, in responding, said he had to tha the members for the courtesy with which they h listened to what he feared was rather a dull pap and he also had to thank those who had spok for the general kindliness of their criticisn He hoped they would pardon him if he he tated to follow so able a debater as Mr. Frew in regard to any question on the increase wealth in France and the United Kingdom, but would certainly take the first opportunity of going the Royal Statistical Society for the purpose of ca fully reading the paper to which Mr. Frewen h referred. With regard to Mr. Brough's criticism he (the speaker) was quite unaware when he w preparing his paper of the figures in Sir Cleme Foster's reports. He imagined that the Board Trade returns in merely giving the volu produced, did not give the value at the pla of production, and he was glad to have be set right on that point. With regard to t Iron Trades Association, he held in his ha a report of the American Trades' Association, and there found that these Associations were investigati the amount of the internal trade. But so far as t average student of statistics in this country w concerned, all that was available were the Board Trade returns, and they did not give the state of t internal trade, but instead they put a telescope to h eyes and told him what the shipping was bringing our ports and not what was taking place within o own lines and centres of industry. The next speake Mr. Rosenbaum, had criticised him rather severe for the copious use he had made of the Board Trade statistics. He held no brief for the Board Trade, but he thought the probable error in their r turns did not exceed two or three per cent. As to t discrepancy pointed out in regard to the tin pla mills, it was an attempt on the part of the Board Trade to depict the state of the internal trad According to Mr. Rosenbaum the Board of Trade w not doing its duty efficiently. His answer to th was that the attempt was a comparatively new on and needed to be supervised not only by statisticia but by committees of manufacturers who were a quainted with the trade. He quite expected to hav his figures as to profits overhauled, but he had alrea explained that the term "profit" was only a relati one. By "profit" throughout the paper he did n mean any profit on which income-tax could be levie

t he merely endeavoured to represent the margin ex-ing between the export and import trades of the intry. According to Mr. Rosenbaum, he had en into the grievous error of taking the Sauerbeck od prices. He was quite aware that the Board of ade gave index numbers as to prices, but he was der the impression that all the Sauerbeck food prices re themselves weighted*, and he had never before ard them criticised. With the permission of the uncil, he would draw a fresh curve, shewing the differ-ce between the co-efficient of food profit as computed the profit margin divided by the Sauerbeck figures, l the same profit margin divided by the Board of ade figures, which he was informed he ought to ve used. He had already pointed out in his paper it iron ores differed very widely in their value and their constituents, he had also given figures show-; not only the production, but the imports of the ferent countries. In conclusion, he thanked Mr. ordenfelt for his kindly appreciation of his (the eaker's) plea for further statistics. It was only ien we had the statistics of the internal trade of e country that we could accurately judge our posi-n. The collection of detailed statistics of our in-nal trade might be looked upon as a third dimen-n in our consideration of the fiscal question. So ig as our computations were based solely on ex-rts and imports, our conclusions being only the oduct of two dimensions would naturally be perficial. Until we had the third, the total lue of our commerce and the relation of our port and import trade to it would remain unknown, d would be the occasion of dragging up many ores of bogies—bogies perhaps which might be ere clouds on the horizon, which the rising sun of a cle of prosperity would dispel. Until we had com-ete returns he feared that so far as judging our tional prosperity was concerned, the Board of rade statistics of import and export trades alone ould only lead to the announcement of many lse hypotheses.

The CHAIRMAN, in thanking Mr. Digby for his iper, said he was sorry that he had not said some-ing about the production of pig iron. A great deal of g iron was imported into this country. If the British on-masters preferred to import pig iron instead of e raw material, surely they were the most ipable of judging which was the cheaper and better an. Although so many aspects had been touched oon, the personal element had not been mentioned. here were people in every industry who would go a business, and in six months would turn a profit-bearing business into a losing concern, and there were others who would do just the opposite. The personal factor had a great deal to do with the prosperity or otherwise of any industry. He really did not see how it was possible to have accurate figures with regard to the internal trade. How often were they to count say a hundredweight of nails, for instance? The manufacturer sold them to the wholesale man, the wholesale man sold to a retailer, the retailer sold to a small man, and so on. Were they to multiply the value of that five times in order to get at the internal trade, or would they simply count the manufactured article, and not take the trading into account at all? It might form a very good amusement for the Statistical Society to take those detailed figures, to add them up, and multiply them and then have a discussion on them, but he did not think it would contribute much to the solution of the fiscal question.

* On the publication of the Board of Trade index numbers st year, Mr. Sauerbeck dealt with the relative question of eighting in the *Journal* of the Royal Statistical Society . 617 [1903]). He states: "As a matter of fact all my imbers from 1867 have also been weighted according to the ital quantity available in the United Kingdom (not the net onsumption only) and according to various systems, but it as only intended to check the results. . . . . "

Correspondence.

POPULAR MOTOR CARS.

Mr. Mervyn O'Gorman writes that he is anxious to thank the motor car companies who kindly supplied him with tests of their engines. He acknowledged their help when reading, but his remarks do not appear in the printed text. He wishes, therefore, to add the following paragraph:—

"I must not fail to publicly thank the Wolsely Motor Car Company, the Ariel Motor Car Company, and the Humber Company for the tests they kindly gave me showing the rise and fall of horse-power of their engines with increasing speed."

General Notes.

CAOUTCHOUC IN GUINEA.—India-rubber was exported last year from the French colony of Guinea to the amount of 1,467 tons, representing a value of more than 14,500,000 fr. (£580,000). Only half this sum was realised in 1900 with nearly the same quantity; and the increase in value is explained by the improved quality due to more careful collection and preparation. These figures are given by M. Famechon, director of customs at Conakry, in a communication which mentions the following circumstances that favour the indiarubber industry in Guinea:—1. Half the vegetation in some districts of great extent in Fouta-Djalon consists of indiarubber plants, only ten per cent. of which have been tapped. 2. The bleeding of a plant, no matter to what extent, does not kill it. 3. While vegetation generally is arrested by bush fires, caoutchouc plants for the most part survive owing to the moisture they contain.

Russian Pumice Stone.—The Russian Government has recently announced that pumice stone has been found within less than two feet and a-half of the surface in the village of Malaya Kutmâ, about four miles from Kars. The pumice lies in horizontal strata, which are two and a-half feet thick. It is very porous and fragile, and is found partly in lumps and partly in triturated, earthy heaps, which contain pieces of spongy pumice of various sizes. Owing to its great fragility it is easily crumbled. Pumice is exported from Kars in two varieties, viz., pure, in lumps, and triturated, combined with other foreign matter. The pure pumice, which is valued in proportion to the size of the lumps, is used for polishing metals, lumber, leather, ivory, &c., as well as for preparing a sort of soap, known as "pumice soap." The scattered pumice is used for preparing hydraulic cement. There is stated to be a project on foot to export the pumice by rail from Kars to the port of Poti, and thence ship it to Odessa.

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday Evenings, at 8 o'clock:—

May 11.—"Early Painting in Miniature." By Richard R. Holmes, C.V.O. Sir William Abney, K.C.B., F.R.S., Chairman of Council, will preside.

Indian Section.

Afternoons, at 4.30 o'clock:—

Thursday, May 12.—"British-Grown Tea." By A. G. Stanton. The Right Hon. Lord George Hamilton, G.C.S.I., M.P., will preside.

Tuesday, May 31.—"The Economic and Industrial Progress and Condition of India." By J. E. O'Conor, C.I.E., late Director-General of Statistics, India.

Applied Art Section.

Tuesday evenings, 8 o'clock:—

May 10.—"Crystalline Glazes and their Application to the Decoration of Pottery." By William Burton. Henry H. S. Cunynghame, C.B., will preside.

May 17.—"Pewter and the Revival of its Use." By Lasenby Liberty. Sir George Birdwood, K.C.I.E., C.S.I., will preside.

Cantor Lectures.

Monday afternoon at 4.30 o'clock:—

Prof. R. Langton Douglas, M.A., "The Majolica and Glazed Earthenware of Tuscany." Three Lectures.

Lecture III.—May 9.—*The Majolica of Montelupo and Cafaggiolo.*—Montelupo an early seat of the manufacture of glazed wares—Its connection w Siena—Lorenzo di Pierfrancesco de' Medici—Fattorini and the Medici—Cafaggiolo—The hist of the villa—Characteristics of the work of Fattorini—The smaller *fabbriche* of Tuscany—later history of majolica in Tuscany.

MEETINGS FOR THE ENSUING WEE

Monday, May 9...Society of Arts, John-str Adelphi, W.C., 8 p.m. (Cantor Lectures.) P R. Langton Douglas, "The Majolica and Gla Earthenware of Tuscany." (Lecture III.)
Royal Institution, Albemarle-street, W., 5 p General Monthly Meeting.
Camera Club, Charing-cross-road, W.C., 8½ p Mr. Egerton Castle, "Romance of Swordsm ship."
Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p. Prof. Edward Hull, "The Thickness of the Ice the former Glacier of the Lucerne Valley."

Tuesday, May 10...Society of Arts, John-stre Adelphi, W.C., 8 p.m. (Applied Art Sectio Mr. William Burton, "Crystalline Glazes a their application to the Decoration of Pottery."
Asiatic, 22, Albemarle-street, W., 3 p.m. Ann Meeting.
Royal Institution, Albemarle-street, W., 5 p. Mr. L. Fletcher, "Meteorites." (Lecture II.)
Medical and Chirurgical, 20, Hanover-sq., W., 8½ p.
Photographic, 66, Russell-square, W.C., 8 p.m. M Howard Farmer, "Progress in Enlarging."
Anthropological, 3, Hanover-square, W., 8½ p.m.
Colonial, Whitehall-rooms, Whitehall-place, S.W 8 p.m. Lady Lugard, "West African Negr land."

Wednesday, May 11...Society of Arts, John-stree Adelphi, W.C., 8 p.m. Mr. Richard R. Holme "Early Painting in Miniature."
Biblical Archæology, 37, Great Russell-stree 4½ p.m.
Geographical, Burlington-house, W., 8 p.m.
Dante, 22, Albemarle-street, W., 8½ p.m. Re J. T. Mitchell, "Dante's Religion."

Thursday, May 12...Society of Arts, John-stree Adelphi, W.C., 4½ p.m. (Indian Section). M A. G. Stanton, "British Grown Tea."
Royal Institution, Albemarle-street, W., 5 p. Mr. Arthur Hassall, "Great Britain and Europ 1763-1793."
Electrical Engineers (at the House of the Socie of Arts), John-street, Adelphi, W.C., 8 p. 1. Discusssion on Messrs. Merz and McLellan paper. 2. Messrs. Parsons, Stoney, and Mart "The Steam Turbine, as applied to Electric Engineering."
Mathematical, 22, Albemarle-street, W., 5½ p.m.

Friday, May 13...Royal Institution, Albemarle-street, W 9 p.m. Mr. M. H. Spielmann, "The Quee Victoria Memorial."
Astronomical, Burlington-house, W., 5 p.m.
Physical, Royal College of Science, South Kensington, S.W., 8 p.m.

Saturday, May 14...Botanic, Inner Circle, Regent's-park N.W., 3¾ p.m.
Royal Institution, Albemarle-street, W., 3 p.m Mr. D. F. Tovey, "Sonata Style and th Sonata Forms," with Musical Illustration (Lecture II.)

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FRIDAY, MAY 13, 1904.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

NEXT WEEK.

Tuesday, May 17, 8 p.m. (Applied Art Section.) Lasenby Liberty, "Pewter, and the Revival of its Use."

CANTOR LECTURES.

Prof. R. Langton Douglas, M.A., delivered, on Monday afternoon, 9th inst., the third and last lecture of his course on "The Majolica and Glazed Earthenware of Tuscany."

A vote of thanks to the lecturer for his interesting course of lectures was passed on the motion of the Chairman.

The lectures will be published in the *Journal* during the summer recess.

APPLIED ART SECTION.

Tuesday, May 10, 1904; H. S. Cunynghame, C.B., in the chair.

The paper read was "Crystalline Glazes and their Applications to the Decoration of Pottery," by William Burton, F.C.S.

The paper and report of the discussion will be published in a future number of the *Journal*.

Proceedings of the Society.

APPLIED ART SECTION.

Tuesday, April 19, 1904; Walter Crane, R.W.S., in the chair.

The Chairman, in calling upon the reader of the paper, said that some persons might feel a little surprised when an eminent landscape painter came forward to speak about decoration, especially when that eminent painter was associated with an institution which had been singularly cold to decorative art. But Mr. Alfred East had given many and distinguished examples in his work of his appreciation of such essential decorative qualities in art as scheme and key of colour, relation of line and mass, and, above all, composition. Hence what he had to say could not fail to be of deep interest.

The paper read was—

THE SENTIMENT OF DECORATION.

By Alfred East, A.R.A.

In dealing with the question of sentiment in decoration, we are brought face to face with the difficulties of definition; even the word Art, instead of being general like Truth and Beauty, is but limited, for when we have to speak of decoration we use the term "applied art" in contradistinction to "fine art," as if there was no quality of decoration in fine art or no fine art expressed in decoration. Again we divide fine art into the sections of painting, sculpture and architecture, and we may divide the decorative arts also. We can take the case in which decoration supports the structural idea, or the other case where the decoration is itself the sole purpose of display. Articles of use come under the former class, where the application of ornament actually assists the structural purpose. In the latter case the ornament superimposed being simply intended to decorate, serves no other purpose but adornment. Wallpapers and textiles, would come under this second classification.

Amongst the multitude of expressed opinion let us endeavour to find some bases of criticism, some means of testing the value of good decoration, by which we can discriminate between what is good and bad, and in what measure sentiment enters, and its justification. Let me point out, in the first place, that where there is an implied service there must be an implied government; and, as decorative art is, in one sense, a subsidiary art, we must see whether it fulfils its purpose of service, and decide when the application of ornament is a gain, and when it is a drawback, for let us never forget that the mere application of ornament is not decoration. This fact cannot be too strongly insisted upon, it is the application of ornament that best suits the purpose that is good decoration, the ornament that not only decorates the article, but supports the sentiment of its use. We might go further, I think, and say that the ornament

which expresses the true structure as well as the sentiment of structure, and so furthers the better adaptability of the object for the purpose for which it was made, is good. That is the test of the application of decoration to useful things. I shall have more to say on the question of sentiment later, but I would point out that this basis of criticism will not serve us in judging designs for wallpapers and textiles, where the purposes of decoration, *qua* decoration, is simply to enrich, and has no structural purpose to support. In this case the designer has a freer hand, as he is not trammelled by the sentiment of construction. There may, however, be a danger in this freedom, for if the designer places upon a rich material any pattern that would disguise the beauty of his material, then it is bad; but if on the other hand he enhances the beauty of that material, it is good. This is the same principle as that the application of ornament must be for the improvement of purpose; in other words, it should support the character of the article upon which it is displayed.

It is doubted by some whether the designer has a right by the application of ornament to disguise the character of the material; it may be contended that in the enrichment produced he has that right. If this be admitted, it opens the question that the designer has the right to deceive, that the material may be taken for something different from what it actually is; the other view is the one that joins issue with that I have already propounded, viz., that the application of ornament should support the character of the material upon which it is applied.

We may leave this vexed question with the remark that if the material be itself rich, then there can be no object in disguising its identity, but if, on the contrary, it be poor, the decorator has reason for consideration if by his skill his pattern claims your attention before his material. Mean things can be made beautiful by the magic touch of the decorator, and in the higher expression of his art. This is an additional interest, inasmuch as the artist embodies within his designs an expression of his own individual appreciation of beauty, an expression of sentiment, but so governed and restrained, that it is made to serve the purpose he has in view. We see certain designs by eminent designers of our day, and we say this is by one, and that is by another. Why do we know this? Because we understand by their previous work the method by which these artists use nature, and select from her what they require for the purpose.

Let us be careful, when we see any origina design, to consider its claims upon its ow merits before venturing to express an opinio lest posterity call us fools. Of course it easy to express an opinion when we have recognised standard before us, but when ne conditions arise, which call forth new expres sions, we must consider the questions afresh taking into consideration those new condition for it would be obviously unfair to criticis from any previously accepted standard, whe the conditions are not the same. Let u remember on the other hand, that the best a of the past has become the convention of t day and in like manner the best modern wor will form the convention of the future. Let u never condemn any art because it is new. W may respect the good work of the past, an honour the craftsmen who produced it, but a the same time we should have the same sel reliance, since we have inherited their re sponsibilities, for I believe we are as capab of sustaining our responsibilities as they we of sustaining theirs. That is the spirit i which we all should work.

For the sake of showing the evolution of th idea of sentiment in decoration we may loo for a while at the causes which led to i wider expression.

Thus: through the Classic, to the Natu ralistic, and so on to the Emotional. I mea by the emotional that quality which express sentiment.

The basis of the classic form, for the sake illustration may be said to rest upon the desi to obtain symmetry by the equal division spaces, thus a typical frieze received a patte distributed with mathematical justness of di tances; it was only when artists introduce the literary idea that they departed from th scientific expression. This may have aris from a highly cultivated intellectuality, a cultu whose attitude towards life was the desire of perfect balance, a system in which no expre sion of sentiment or expression of the emotio found a place; but which united the idea of life set up by the designers and their attitu towards art. Such an attitude, however, w dangerously near becoming the expression of mere scientific formula. It was like a su that was proved; it was finished, and nothi more could be said, as it leaves us uninterest and cold. From this Hellenic idea of t perfect justness and balance which is so pr dominant in the work of the Greeks, the

rose in the Græco-Roman period a softer ·eling, a more human touch, which long fterwards culminated in the decadence of the urely classic idea. In its place was developed n order of decoration founded upon the actual ›rms and colours of nature. The early Italians o doubt being influenced by many different ›nditions of life from those which had governed ıe thoughts of their forefathers of Pagan mes, and coming into contact with a religion ı which the human interest was the dominant ›te, they would naturally be inclined to express in their decoration, as they did in their ne art, those feelings which were engendered y the Christian idea. Christianity was a ·al thing to them, and their pictures served › illustrate the facts of the lives of its founders, ıerefore it was but natural that these decoraons should express real things. This feeling as no doubt enhanced by their love of colour. he sumptuous pigment of their pictures found place in their decoration. The introduction this frank materialism may be a protest gainst the cold formality of the classic school, which, instead of a methodical distribution pattern, we get the festoons of fruit and ›wers, &c., realised with all the imitative culty of which the artists were capable. It is the evil example, I think, of this work which to be found in some of the old palaces of Italy, ·rtainly in the galleries of the Vatican, that e degraded decoration of the modern Italian ›use can be traced. It seems to have been a otest against the cold formalism of a preous order, a rebound from former lifessness. Be that as it may, it was one of e interesting phases preceding a later ·velopment, which was to come through a der outlook and increased freedom ; probably e Reformation and later the French Revolu›n had much to do with this. Men began to ink more for themselves in religion and politics, ıd why not in art ; it broadened their power for e inception of new ideas, and had the result of eparing the way for the dawn of that quality ıich marks the art of to-day. Not only is ıe art affected by it, but its influence is felt the decorative arts.

No doubt this freedom brought with it il as well as good, and whatever were the il consequences of the overthrow of all cepted traditions in the past, there arose ›m amongst the banalities of decorative art our time the beautiful flower of a truer pression of what was the personal chacter of the man. It may be an open ıestion whether we are sufficiently educated to enjoy this full freedom, and to be entrusted with this greater responsibility. We know that many, in their freedom, not only throw over the formalism of the past, but unfortunately discard its principles as well. The consequence is, that more bad things are done than were possible under the restraining influence of the classic school. If the craftsman could invent nothing in the earlier days, he had at least authorities which every one expected, to copy from, and could thus be saved from complete failure. But how different is the designer of to-day ; he is expected if he has anything to do or say, to have the courage of his own opinion. His field of work had become vastly wider. Altered conditions of life, increase of wealth, love of change, were some of the new conditions imposed upon him, and although it gave the opportunity for the impostor, it also gave a freer field to the qualified man. All are displayed before the public, and it places upon the public a responsibility of choice. What are they to do ? In the old days they could have appealed to accomplished facts and to tradition. They could see that, inasmuch as the thing produced conformed to these traditions, it was good, while inasmuch as it did not do so, it was bad ; but where are the standards for the poor "man in the street," now ? For the craftsman himself, having lost the steadying influence of past experience, constantly shifted his ground —sometimes to this side, and sometimes to that. The weak man either hung upon the old forms, or timidly imitated the new. A leader might arise, and, immediately after his recognition, a crowd of followers who had not force of character to do anything of their own, would present a diluted representation of the stronger man's work.

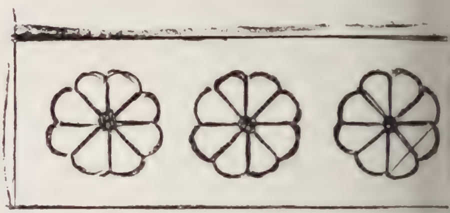
But we have at last felt our feet, and have regained a confidence that has impressed itself upon the work of to-day. At no time in the history of decorative or fine art has this confident personal factor been so dominantly expressed ; no doubt it is the result of many influences, but these influences coming into contact with open minds made an impression, which was to bear fruit in a different form from that which governed the older school. The material was ripe for these impressions, and amongst the varied influences, was one of the first importance, and that was the personal or individual expression of the artist's opinion, an opinion which was engendered by his own surroundings. Perhaps

the first was the influence of other countries. I believe that much may be attributed to Japanese art. We know that the art of China was introduced to Japan a thousand years ago, and we know also how it became assimilated by the Japanese, and so the art of Japan has been (more or less) assimilated by us. One very interesting characteristic we have adopted, if not in the letter, yet in the spirit, is the strong quality which had been so rare in ancient decorative art, that is the quality of sentiment.

May I be allowed for a minute to digress, to to explain what I mean by sentiment? I mean by the term sentiment, not exactly the expression of human emotion, such as is expressed in pictorial art, wherein the option of the designer, which is a human quality, enters into his work, and the suggestion that there is something further than a mere expression of a mathematical conclusion, something not arrived at by a series of forms of equal size displayed at equal intervals, but of unequal forms so placed that the *ensemble* is satisfactory, conforming to the desire for symmetry and balance.

May I remind you that the straight line and curve form the bases of all pattern, that the straight line treated as a symbol expresses no sentiment, because it is a definite thing. It suggests nothing beyond itself, it has no irregularities, no sense of movement, it is dead, and admits of no question. It depends upon one simple fact—that it is straight. Not so the curved line—continue this, and you make a completed figure. No figure can be made with a straight line, it requires a series of straight lines in contact or conjunction to produce a figure, whereas a curve has, within itself, an element of suggestion. Now this is my point, that the arc of a curve is at the discretion of the designer and can be modified and increased to serve the purpose of his decoration. It is not so with the straight line, which is not amenable to any such use, for a straight line expresses death and the curved line, vitality. The field for decoration with straight lines is a very limited one, except by the addition of lines which may form angles, but that of the curve is practically unlimited. Where the two are used in conjunction there is opened out to the designer the whole possibility of change, by which the personality of the designer may be fully manifested. Let us take, for the sake of illustration, two panels, one decorated by patterns arranged in geometrical order, the spaces between each, and the edges of tl panels are equal. That expresses no sent ment, it might continue, like a straight lin *ad infinitum*, but take another panel of tl same proportions, and place upon it a curv line of unequal direction, you will at once op the door for a hundred possibilities of form.

The Japanese has taught us the value this inequality which we call sentiment—wh he describes a synthetic line in his design a refreshes it with a counterpoint of some inten colour, you may ask where does the princip of symmetry enter—where is the satisfa tion that the space is perfectly decorated



How can it satisfy the observer that it is jus Will you please notice that in this Japane design there is included the same element proportion as in the classic form, although differently expressed; as I said before, the o admits of few variations, while the other adm of many. You will see that the area cover by the half tone of the Japanese design much larger on the one end of the panel th the other, and the counterpoint is so plac that there is a perfect sense of balance. Y will observe that the aggregate of display half tone is equal to the small condens

These figures are reduced from rough sketches made Mr. East at the meeting.

iterpoint, thus establishing a perfect sense he balance of parts. We might com- it with a pair of scales, in one scale is a ·ht of iron and in the other a bag of ners. The bag of feathers must of necessity irger in bulk although it balances the iron— :he mathematical distribution of ornament be compared with the weight in the one e and a piece of metal in the other. The nce being obtained without disproportion ilk. This decorative arrangement of bulk t is light and dark) is called by the Chinese otan," a quality for which we have in lish no specific name.

this difference of bulk arises the idea of iment, a quality that fine art shares with ied art. For a picture so composed that it s one a sense of unrest in its arrangements uantities, is not good. In landscape paint- this inequality of quantities is accepted ost as a principle, for we seldom see a pic- that is satisfactory in its composition that ats the same forms without variation across canvas; this element of inequality forms the dation of the expression of sentiment in oration.

he artist has the option, like the designer, noice of all material things; to him is given iority on the whole earth. If he doubts his iority, and with a timid heart takes what es first to his hand, he exerts no authority hoice. He is permitted to select what equires from nature that will best serve purpose. We laugh at a man who berately selects wood when iron would be er, or *vice versâ*, therefore we may give to artist or designer the same freedom of ce. If the artist desires this or that, it is he can take it, and in this freedom he t recognise his responsibility. There is no ise for him to say that what he produces is nature. That is not enough, the camera do that; but he has so to use his opportu- that it will become the medium of his own ression of love or praise, or in the case of designer, if he has not the ability to select se forms which best suit his purpose, be purpose what it may. Herein lies his onsibility, and herein lies hls pieasure also. claim that no matter how well a picture its story, if it offends this principle of fine position it is not great, there is no reason a picture should not be equally true to ire, and yet be so composed that it be called decorative. I do not quite this word decorative as applied to fine because I think it is generally used in a wrong sense: fitting contains I think a better meaning. If the artist or crafts- man deems a certain quantity of lights and darks, or a certain quantity of colours in con- junction, to be fitting for his purpose, no matter if he be designing a carpet or a land- scape, then he may call it decorative, but there is a feeling abroad that the decorative picture should lose something by the fact that that it is decorative. I wish to protest against the acceptance of the word in that sense. I would rather have the one which is conveyed by the word fitting, because then it will be more easily understood that the landscape painter is perfectly within his rights when he selects his trees from nature, which will be the most fitting and suitable for his composition. The result will be, in the best sense of the term, decorative. There is also the feeling abroad that this quality in some way or other detracts from the qualities we should look for in a fine work of art, such as fine feeling and high sentiment. May I ask you if it is so in the case of Turner and Titian? In the case of Turner, not only is his black and white admirably arranged, but his other colours conform to the same arrangement, and yet we cannot say that they live by the merit of being decorative only.

This sentiment or movement is the pre- dominant quality expressed in modern applied art. The decorative artist is not satisfied by merely covering his surfaces with ornament, but he has created forms that harmonise and sup- port the useful purpose of the article upon which he has placed them. There is no doubt that the materialistic features were unsuitable for deco- ration; they offended the sense of the fitness of things. We are not, now, pleased to put our slippers upon the recumbent tiger, however peacefully he may be disposed on the woolwork of the rug, the gentle lamb upon the otto- man, which seems so unconcerned by the proximity of the tiger, raises no enthusiasm in our hearts, and we have condemned them to the limbo they deserved, there was an attempted revival of bad taste a short time ago in the way of painted stools and iron pots, and long drain pipes for umbrella stands, but they have succumbed to sensible and rational things; if in this new art it becomes extravagant or *outré*, these extravagances will disappear before the common sense requirements of a useful purpose. A chair is beautiful when it is constructed on fine lines, but, if, in its construction, it loses its useful purpose, it cannot be considered beautiful. The

reason why those of Chippendale are examples of good taste to-day is, that they never lost their useful purpose by the application of art.

This sentiment of decoration is not only expressed by application to useful purposes, but it is enhanced by the abandonment of the imitative quality which mars so much otherwise good work. We may admire a modern Sèvres vase for its paste and glaze, but it is at once condemned for its hideous attempt at deception in the way of painted flowers. We want flowers *in* the vases, not upon them. How true is the instinct of the Japanese in this respect, they never select a vase which is to hold flowers that can in any way compete with the flowers that it is to hold.

There is another matter which, although not bearing directly upon the subject in hand, is interesting, as an evolution of design. I refer to some of the newest inventions; take for instance the motor car. Contrast some of the newest designs of the motor car with the horrible motor cab, in the one you feel that horses are not required, and that it can do its own work itself, but in the other case we ask where are the horses? for the vehicle seems incomplete without them. The evolution of the locomotive and railway carriage and a hundred other things point to the fact that we are not merely satisfied that the thing *can* do the work, but that it should possess the appearance, that it can do it also. It is not merely necessary that an iron bridge be strong and suited for the purpose of its construction, but it should also possess the sentiment of that strength which conveys to the mind the suitability for its purpose. A bridge that is actually strong enough may have the appearance that it is too fragile, or, on the contrary, too clumsy. The appearance, as well as the use, is what we desire to see. This is what we may call the sentiment of applied art in another sense.

The application of any decoration to an iron bridge which does not support the idea of strength, is out of place, for no ornamentation can be tolerated if merely used for ornament. It must support and enhance the appearance of its purpose. Our intellect is constantly being called upon to justify errors of this kind; for example, we know perfectly well that there is a solid mass of concrete or stone to which the rods of a suspension bridge are attached beneath the earth, our intelligence informs us that it must be so, but still, as there is no visible proof that it is so, we feel that the sentiment, as well as the fact, is not expressed. This sentiment is an art factor which is, to-day, more and more appreciated; it is only to be excluded when a higher necessity intervenes to prevent its adoption. For instance, we find in our plate-glass shop-fronted houses, the whole superstructure apparently resting upon the glass, and we have accepted this with a feeling that it is one of those exceptions in which merely its useful purpose has a claim. Personally I do not think so, but a shopkeeper will tell you that in proportion to the space in which he can show his goods, so is his proportion of business done.

But, as a last word, let me say when the designer has a free hand, he can, to a very eminent degree, express himself with that freedom which has led to the advancement of his art. Being freed from the trammels which thwarted him at every turn, he ought to have developed a new expression, he has been placed in a position which is unique in history. At no time had he before him such a variety of articles upon which he can express his decorative skill. At no time had he so much data of previous forms of applied art. Quicker and cheaper forms of intercommunication of country with country have given him a wider field of study, and the multiplicity of articles to decorate, gives him the opportunity of exerting his invention. Has he responded to his opportunity? I think in a great measure he has, for if he has abandoned the purely naturalistic forms for conventional naturalistic ones, these conventionalised forms in themselves have become beautiful, more interesting to us, because their elements which he has selected from nature have been impressed by his own personality, the natural objects have received an additional interest because he has made them conform to his own conventions. His art is nearer to nature because he has observed the laws of nature, that is to say, he has sought that the object he constructs should serve the purposes of its construction, which is the first law of nature. Herein lies the great possibility of this new order of decoration; it must and will influence our lives and make itself felt throughout our applied art, and add dignity and style to our fine art, and what is "style" in art but the perfect display of contour and quantities within the given area of the canvas, in which form and colour unite to raise the highest sentiment and the finest feeling of the subject painted.

Pictures considered as a decoration should reach the highest possibility of that purpose,

and there is no reason why they should lose one jot or tittle of these qualities which we have hitherto considered as fine art. As I have said before, the fitness of things is a quality which ennobles a work of art, and no picture, no matter with what technical skill it be painted, and no matter how well it may tell the story it seeks to illustrate, if it is not fine in composition, with a perfect expression of balance of parts, it cannot be a great work. Many of our younger painters are satisfied with painting a "bit" from nature on an extravagant scale, and no matter how large, it still remains a "bit" and not a completed thing. It is as useless to expect to find a ready-made composition for a noble landscape in nature as it is to expect to find the pattern for an iron stove. Man must come in with his undoubted authority, and take from nature what he wants for his purpose, and mould it to his use, be it a design for a wall paper or a picture, and all that which suits the purpose of his intention, and I should make this answer if any one asked me how am I to know a good design from a bad one. I should reply that all good design assists the purpose of the article upon which it is placed, and bad design spoils that purpose.

DISCUSSION.

The CHAIRMAN said that he felt himself very generally in agreement with Mr. East's interesting and suggestive paper, but he might be allowed to offer one or two criticisms from his point of view. In the first place, Mr. East seemed to fall a little foul of the definitions of "fine art" and "applied art." These always appeared to him (the Chairman) to be unsatisfactory. Still, he must not say much as applied art was the very title of this section of the Society. But applied art always suggested to him a postage stamp moistened and stuck on to something else. Of course all art was applied. The real difference between one kind of art and another was the way in which they were conditioned. All art was conditioned in some way. Even the painter at the easel was conditioned by the size of his canvas, and by his colour-scheme, and, of course, by his subject. This seemed to point to the necessity of a rather more subtle classification. The term applied art was not sufficient to cover the immense varieties. He would not presume to offer fresh terms, but persuaded as he was of the essential unity of all art, he strongly objected to the present definitions. It seemed to him that the decorative side must come in some way into all forms of art. It might be called the euphony of art. It was connected with the power of expressing what an artist had to say, and it would be called euphony in literature. Art must be put in some pleasant form or no one would look at it, and it could hardly avoid being decorative. The very finest art was strictly decorative. Mr. East spoke of the designers of textiles and wall-papers, as being very free, but he (the Chairman) did not feel that they could quite career along the wall as they liked. They were, after all, controlled by what might be called structural conditions. The proportions or appearance of a wall could be made or marred by a pattern, and the designer could not disregard considerations of construction. This, he thought, held true throughout the whole region of decorative art. He was glad to hear Mr. East say that he thought that our conventions had been derived from the best of ancient time, but he wished that he could himself think so. Mr. East had said that the straight line did not convey sentiment, but it appeared to him (the Chairman) on looking at the massive simplicity of the structures of ancient Egypt and Greece, principally composed of verticals and horizontals, that they conveyed the sentiment of repose and stability; and the mural decorations of the Egyptians, arranged in horizontal lines, accentuated this, and conveyed a sentiment of mystery, apart from their representations of daily life which, of course, were full of variety and interest, and were, in fact, pictured stories. Mr. East had effectively pointed to the measured balance of symmetric art represented by the Greeks, but here again there were more or less structural necessities. The ornament of the ancient Greeks was really the human figure. It was a living and vital ornament which expressed their ideas, and he believed that they intentionally kept the architectural framework moulding very forma and restricted and measured for the same reason that a modern artist would object to the frame of his picture being of such a character as to take the interest away from the picture. Mr. East had spoken of freedom in art. Well, of course, there was a difference between freedom and licence. In ages when there was a loss of faith and a general break up of traditions, of course the balance was apt to be lost, but he thought that it was not so much liberty as licence that was indulged in at this time. Real freedom seemed to be rather represented by a state of growth in art such as was found in the middle ages, when there was a sound tradition of structure and design going on. This tradition by no means enslaved individuals, and artists designed quite freely, without feeling any restriction from the style of their time, just as a writer nowadays could write freely without bursting beyond the bounds of grammar and the ordinary understanding of our speech. Without disallowing the element of sentiment in design, he would suggest that design looked at as a whole was divided into *formal* and *informal*, and that both had their proper means of expression. Where a thing was absolutely measured and scientifically exact, it failed to convey any human sentiment. The great point of course in all art was selection. He did not know how the idea

got abroad that decorative art was necessarily less naturalistic than any other, but of course the mind of each period required a new interpretation of nature, and saw nature through certain spectacles, the colour of those spectacles being gained from all sorts of curious subtle sources. He believed that every age would continue to require that re-interpretation. But still as regarded decorative art, he believed that it was merely a difference of selection. The designer of a floral pattern might be able to embody in his design quite as many facts of nature as the pictorial artist who gave the effect of light and relief. It was very interesting to have Mr. East's opinion upon the design of the motor car. To his (the Chairman's) mind all the forms which he had seen, left much to be desired. As to the suspension bridge, he thought that he had become convinced by this time that there was a proper attachment. The power of association was, after all, everything with regard to these things, and that was the great difficulty in the way of introducing anything new and convincing people that it was all right. He supposed that in time people in towns would get to admire the style of architecture that was now prevalent. The magnificent plate-glass upon which apparently rested the whole of the structure above, might in time strike people as being very fine. He did not want to live to see that day.

Sir George Birdwood, K.C.I.E., C.S.I., said he was in no way entitled to say whether he agreed or not with the views put forward by Mr. Alfred East. He had, however, been charmed with Mr. East's paper as a great intellectual treat, for it dealt with a quite original text, and was impressive by reason of the earnestness with which Mr. East had supported its thesis, and, so far at least, it seemed to him convincing. He entirely agreed with what their distinguished Chairman had said regarding the arbitrary definition of the terms used in art. They were but rule of thumb definitions, and as such they were absolutely necessary, but they had little philosophical basis, and should not be used for the purpose of drawing any hard and fast lines between "the fine arts," so called, and the so called "applied arts." It was very remarkable how many words expressive of all kinds of energy were radically one with the word art. They all go back to an Aryan root, *ar* or *er*, signifying "to move," "propel," "lift up," "arise," "grow," "join," "fit together," "achieve," "excel":—the first historical derivatives of which are the Sanskrit *arnoti*, "lifts up," "succeeds," *aretram*, "an oar," "a rudder" ["*i.e.* scull"], *aranyas* a "growing" wood, *arya* "a plougher," *aryas*, "worthy," "true," "friendly," and the Old Persian *areta* "high," "excellent," "virtuous," and *ratu* "law," "order," [and "rates" and taxes!]. Branching away from these off-shoots we have: A, through *areta*, such words as the Greek *ornis* "a bird," *arotron* "a plough," *eretmos* "an oar"; the Latin "*origo*" a start, the beginning, "*oriens*" rising, "*arum*" the Lord and Lady lily, "*arundo*" a reed, "alere" to nourish, make grow, "arare" to plough, &c.; and the English to ear, *i.e.*, to plough, earth, earnest errand, April ["aperire"], row, rudder, rullock, &c.: and B, through *arya*, such words as the Greek Ares, the "brave" God of Arms, *armozo* "I construct" *armos* masonry — "construction," *harmonia* "a fastening," "harmony"; the Latin "ars" art, "iners" inert, "sollertia" skill, "arma" arms, "ratio" proportion; and the English artist, artisan, artillery, armada, aumbey, aristocracy, arithmetic, artery, rhyme, &c. The very etymology of the word art therefore indicates that it was a common term for all the arts, the theoretical and practical, and the fine and applied, and the mechanical: —of which Cicero has told us [Oratio pro Archia I.] that they all have a common origin, and that each one in itself contains every other. The word art is indeed a common term for all the energies of nature engaged in the evolution of cosmical order and beauty, whether operating through the laws, *i.e.*, the properties, of the so-called elements* of chemistry, or the genius of statesmen, conquerors, poets, painters, and sculptors, or the grace, and good works of godly men and women. The word encompasses, and is encompassed by, and interpenetrates, and is interpenetrated by, all such words as *theos*, "deus," "numen" [Pliny II., 1, 1], divinity, divine, &c.: and in its highest significance refers directly to, and is identical with, the self-existent, self-contained, creative force [the principle of movement, "causa efficiens"] in which the universal frame [matter and form] of Nature has its eternal being. Aristotle, illustrating the four kinds of causes, observes, "in a house the *principle of movement* is the art of the architect, the *matter* the stones and cement, the *form* the plan, and its *final cause* [*to agathon*, "goodness," "nobility"] the serviceability of the work." Cicero says of Nature, "non artificiosa solum, sed plane Artifex." Dante refers to the Deity under the beautiful epithet of the "Eternal Gardener" *ortolano eterno*. Nature is not only clothed in beauty, but her very head spring and source is the divine instinct for order and beauty. In theological language:—"the whole

* The word element is also generally derived from the root *ar* or *er*, like the word aliment. But the Romans really made it up of the three letters of the alphabet, l, m, and n [el-em-en (*tum*)], and they used the word for the alphabet; the word alphabet being a Low Latin formation from the Greek names of the two first letters of the alphabet. The elements are the abecedary, or rather the syllabary—"the mysterious 'A O,'" "Alpha and Omega,"—of creation. The Romans drew on any land they had to survey two transverse lines ["crux decussata"] along which they traced the letters employed by them as numerals ["numerorum notæ," "n: signi"] in casting up its area and circumference. This is the origin of the archaiac Christian "Ceremony of the Alphat," be still observed in the Catholic Roman Church; that is, the tracing of the alphabet. from *alpha* to *omega*, in the figure of a St. Andrew's Cross, on any land solemnly dedicated to the service of Christ: and this ecclesiastical rite is the explanation of the phrase "Criss-Cross-Row" or "Cross-Row" applied to the alphabet. See Donne's *Polydoron*.

creation groaneth and travailleth together . . . waiting for the adoption, to wit, the redemption of our body from the bondage of corruption into the glorious liberty of the children of God."* "In brief," to quote Sir Thomas Browne [*Religio Medici* I. xvi], "all things are artificial, for Nature is the Art of God."

"All are but parts of one stupendous whole,
Whose body Nature is and God the Soul."

Mr. Lewis Day said that he must protest against the Chairman's protest against the use of the term "applied art." He was sorry that he should give the weight of his authority to the common idea that applied art was "something like sticking on a postage stamp." It was true that art was one; but art manifested itself in very different ways, and, as Sir George Birdwood had said, we must have something like working definitions; we must have terms to distinguish between the graphic art of the man intent on presenting a portrait or a record, and the art of the man who was decorating something. Though art might be one, different artists looked at it from different points of view. Referring to Mr. East's paper, Mr. Day said that he seemed to be under the impression that he was saying something rather revolutionary about decorative art; but really he had enunciated the most respectable sentiment, and had said nothing even a bigoted ornamentist like himself could find fault with. He was delighted to hear him say that to urge that a thing was like nature was no excuse. He thought that a great deal of the unsatisfactoriness of art arose out of artists supposing that when they had made a thing like nature the trick was done. He agreed with what the Chairman had said in referring to the straight line. The straight line did express something, repose and strength, and so forth. Mr. East had seemed to fall into the old fallacy about "The line of beauty." The longer he lived the more he saw what pernicious nonsense that theory was—the advocacy of Hogarth notwithstanding. Straight lines had an enormous value in decoration. He thought that the Greek ornament had more to recommend it than the sketchy ornament of the Japanese. The Greeks knew what they were about when they drew the old key pattern. Perhaps people got sick of that pattern, but he believed that they got much more sick of the modern squirm. The mathematical distribution of design of which Mr. East spoke was not mathematical in the sense that it was done mathematically. The man who worked on formal lines did not necessarily start mathematically, but he fell into symmetrical lines. Mr. East had spoken about modern art, and our freedom nowadays from trammels; but he (Mr. Day) did not think that we needed to be very proud about that freedom. He believed that the trammels helped the men of old to do the good work they did. We had greater freedom—freedom to go wrong—and we went wrong. We had no standard, and there was the pity of it. As to the modern artist's freedom to express their own opinions, how many of them had any opinion to express?

Mr. Hugh Stannus said that he had listened to Mr. East with great interest. When Mr. East was enunciating his principles, he was carried back in his mind to something like twenty-five or thirty years ago, when he began lecturing on this subject, and when he spoke very much as Mr. East had been speaking this evening. Mr. East had spoken about lines, but he had omitted what was far more important than the line, and that was the attitude of the line. The Chairman dealt admirably with that subject in a series of articles in one of the illustrated papers in which he showed that the attitude of the line was of the greatest importance; and any judgment would be certainly incomplete without considering whether the line was vertical or horizontal or oblique. He did not altogether like Mr. East's distinction between fine art and applied art. Applied art was fine art, and the finest art in the world was applied to the Parthenon. He would prefer to use the two terms "applied art" and "movable art." Art applied to a building was applied art, but the art which was painted on a canvas which could be hung in different places was movable art. The same consideration applied to a piece of sculpture. The movability must naturally detract from the highest nature of that art. It was, he thought, much better to speak of applied art and movable art. He was reminded of a saying of Ruskin that the greatest art was that which was done for its place in its place. He also felt that they had been agreeing all through the paper, only he would wish to alter some of Mr. East's definitions. He had spoken of Symmetry and he had referred to Japanese design, but he (Mr. Stannus) would suggest that that was not an example of Symmetry, but rather an example of Balance. He did not like Mr. East's expression about "supporting the character" of an object. He took it that what was meant, was that the decoration had to "suggest the use" of the thing to which it was applied and that that would be a better expression than "supporting the character." The decoration might co-exist with the use either congruously on incongruously, or neutrally. He might take for his example the splash-cloth which was put behind a washstand to protect the wall. If the picture on the splash-cloth had anything to do with water there would be a certain congruity about it, but if it had anything to do with birds in a nest, the design would be incongrous. And, so it would be, if it represented kittens. He remembered that some years ago, there was a great run on kittens. They had them on everything. For instance, one would be painted on a coal-scuttle. Decoration should further be congruous with the material and not disguise it, and it should be arranged so that when the article had to be repaired the decoration would not have to be pulled to pieces. He did not agree with the

* *See* Henry Vaughan's hymn, "Etenim res Creatæ."

manner in which Mr. East spoke of festoons. He (Mr. Stannus) had tabooed festoons because they were such an easy expedient for hiding one's want of thought, but in the old days, the festoons in the temple had a symbolic value. The symbolism of one age became, no doubt, the stock in trade of the next, but whenever we saw symbolism we ought not necessarily to decry it. He thought that the corrective for the swinging of the pendulum in art first towards one craze and then towards another would be the establishment of small well-administered museums which would refuse to receive anything that had not teaching in it. To his mind the great value of Mr. East's paper was the delightful freshness with which he had approached the subject from the pictorial standpoint or the standpoint of the picture maker.

Mr. ALFRED EAST, in reply, said he was not aware that the principles he had enunciated in his paper had been discussed before, and he was interested to learn, on Mr. Stannus's assurance, that something had been done in that direction so long ago. He said that Mr. Stannus touched upon rather dangerous ground when he complained that a picture was degraded on account of its movability. His reply to that remark was that a picture was painted for a man and not for a room, just as a book was written for a man to be read by a man, and not merely to have a place in a library. He could not agree with him in supporting the imitation of flowers and fruit in festoons in marble. He preferred that such representations should be connected with the right thing or not used at all. He objected on broad lines that imitation was not art no matter whether it had the respectability of age or not. The artists of to-day ought to have the courage of their opinions, and when they saw the wretched and miserable designs of the past they ought to have the courage to say what they thought about them. Sir George Birdwood had referred to Japanese art. He (Mr. East) had not said a word in its praise, and on the other hand he did not condemn it. He only spoke of its influence upon English art. That was the only aspect of Japanese art with which he was concerned now—Japanese art was as conventional in its own country as English art was here. The so-called Greek key pattern was used in Japan as much as in Greece. The geometrical order of design in Japan was more common than what might be called the emotional order. He thought that it was quite possible that it might have been a spontaneous suggestion, as many of the orders of decoration were throughout the world. They were not to be traced to any particular influence, but had been evolved independently in their several countries. He protested against the assumption that painters were not designers. Those things which imitated nature, such as the festoons of marble which had been so much admired, did not come into the category of art at all. As far as art was concerned, man would be helpless without nature, and nature would be helpless without man. He was not there to say one word against decorative art. He thought that all art was one; personally speaking, he had much interest in decorative art. He thought that all art was "fine." It was only a matter of degree. He wanted to say a few words with regard to Mr. Day's remarks. He thought there was some misunderstanding as to what he meant by a line or a figure altogether dissociated with solidity. They could not let the designers have it all their own way. There was a point which the designer might take to heart, and that was the emotion or the sentiment expressed by a certain conjunction of certain areas, or rather, the emotion or sentiment expressed by colour of certain areas in conjunction. He took it that colour in certain areas in conjunction could express an emotion. The main thought which he wished to express in the paper was, that when people saw a pattern, whether it be in the spacing of a page of a book or in the design of its cover, or in the design of a wall paper, or anything that man touched, there was an emotion aroused, and we took a deeper interest in it. It made life a wider and more beautiful thing to feel a human interest in the articles that were of daily use. A man's character was felt in his painting, in his poetry, or in his music. They could not get away from the decorator. If he was a bad man he might drive them into a lunatic asylum, or if he was a good man he might give them something worth living for. He wanted to wake a decorator up to his responsibilities! They were all waiting to appreciate the decorator if he would but give them the opportunity. When ornament was applied to anything it ought to support the construction. If it did this it would add a charm to the thing. He hoped that artists would be willing to accept the responsibility of their own day. He did not think that even the Greeks or the Egyptians took full advantage of their opportunities; they produced very fine decorative work in the embellishment of their temples. But, we ought to have the courage to express our own opinions. It ought to be remembered, that in the service of art there was perfect freedom, and that the objective of art was man's appreciation. The architect was the person who set the note and who struck the key, and to that all the other art must conform, if it was to be decorative. The designer of the wall paper must accept the conditions laid down by the architect. It was not the fault of the designer if the wall paper did not suit the area which it had to cover. The fault often rested with the person who selected the paper, and not with the designer; but the designer should remember that people did wish to have pictures on the walls, and he had no right to discourage them by putting a paper on the wall that would make it impossible.

The meeting was concluded by a vote of thanks to Mr. East.

TWENTIETH ORDINARY MEETING.

Wednesday, May 11, 1904; SIR WILLIAM ABNEY, K.C.B., D.C.L., D.Sc., F.R.S., Vice-President and Chairman of the Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Clews, Henry, LL.D., 11, Broad-street, New York City, U.S.A.
Cole, Professor J. Abayomi, Percival-street, Freetown, Sierra Leone, West Africa.
Davis, Charles, 147, New Bond-street, W.
Fleischmann, F. N. A., F.C.S., 6, Collingham-gardens, S.W.
Gardiner, James, Molyneux-park-mansions, Tunbridge Wells.
Tween, Charles Nelson, M.Inst.C.E., Goddards, Widford, Ware, Herts.

The following candidates were balloted for and duly elected members of the Society:—

Bell, Mrs. Jeannette, Rotherby-hall, Leicester.
Bright, Miss Agnes, Winton-house, Leamington.
Chester, Arthur, A.I.E.E., 26, Balmoral-chambers, Commissioner-street (P.O. Box 3817), Johannesburg, Transvaal, South Africa.
Hindley, Oliver Walter, B.A., Assoc.M.Inst.C.E., care of Messrs. King, King and Co., Bombay, India.
MacCarthy, John Leader, B.A., Assoc.M.Inst.C.E., Compass-hill, Kinsale, co. Cork.
Vare, William Edmund, Mem.San.Inst., Bodorgan, Mayfield-road, Weybridge, Surrey.

The paper read was—

EARLY PAINTING IN MINIATURE.

By RICHARD R. HOLMES, C.V.O.

While reading Walpole's "Anecdotes of Painting," I was many years ago much impressed by the high estimate he formed of the extraordinary ability of Samuel Cooper. He says, "If a glass could expand Cooper's pictures to the size of Vandyck's they would appear to have been painted for that proportion." I have long wished to try this experiment, not only on the works of Cooper, but on those of painters in little, many of whom are hardly, if at all, inferior to Cooper in portrayal of character or in technical excellence. Till very recently this was impossible, as the methods of reproduction were imperfect, and enlargements in monochrome were not satisfactory. Now, however, we are enabled, by the adaptation of new processes of colour-photography, to give in life-size the actual facsimile of the exquisite work produced by the great masters of miniature painting.

I presume, by the way, that I need hardly explain to my present audience that the term, "miniature," originally had nothing whatever to do with smallness, but is derived from minium—the red paint known as vermilion. This was used in the earlier MSS. for capital letters, for headings of chapters, and so forth. The capital letters, in process of time, received decoration, and as art progressed they were used to contain small pictorial representations of subjects in the text. The headings of the chapters and explanatory notes still remained red, and have retained the name of *rubrics*. The pictorial decorations of the MSS. gradually assumed more and more importance, but retained this original name, which has since been given to all paintings in little, and now is generally adopted as expressing almost exclusively something reduced in size or minimised.

Some of the earliest and finest of existing portraits of personages of note are to be found among the little pictures or miniatures which adorn the illuminated books of the Middle Ages. One I would specially mention, as the unique portrait of an Englishman of renown in his day, John, Duke of Bedford, Regent of France, after the death of his brother, Henry V. This is of the date of 1433, and is, therefore, one of the earliest of existing portraits. It is preserved in the British Museum, and I hope to include it some day in the series of illustrations which I have in preparation, and of which I am showing you the first selection this evening. We cannot unhappily claim the painter as a countryman, and this evening the illustrations are confined to portraits painted in this country.

Apart from the illuminations in service books of various kinds, we may generally assume that the art of portraiture in miniature began with Holbein, whom, though not an Englishman by birth, we may claim as partly English, as here he did most of his fine work; here he lived as servant of the King, and here he died and was buried. Of his merits as a draughtsman or as a painter it is impossible to speak too highly. He ranks as equal with the greatest masters of all time. No eye was ever more observant to see form and character; no hand has ever excelled his in delineating with accuracy and precision what his eye had noted; and no lens has ever equalled his accuracy in portraiture.

Of his works in the particular form of art which is our subject this evening, there exist, perhaps, a score. Of these, there are four examples in the royal collection at Windsor, of the highest excellence, and reproductions of these will now be shown to you in colour, and magnified to the size of life.

The first of these is Henry Brandon, the eldest son of the great Duke of Suffolk, the husband of Mary, sister of Henry VIII. This miniature was painted in 1535, on his fifth birthday, the 6th of September. He died in 1551, having succeeded his father in the dukedom. He fell a victim to the falling sickness, and must always have been of a weakly constitution, as may be noticed by the pathetic look in his eyes.

The workmanship of this painting is of the most marvellous delicacy, and the lines of the features, though the face is only half an inch wide, are of a strength and firmness equal to those in the drawings still preserved at Windsor, of which the facsimiles are known over the whole world of art.

The next slide is the portrait of his younger brother Charles, who was born in 1537, and died on the same day and of the same sickness as his brother, whom he succeeded, though he held the title only for a few hours.

This miniature was painted also on his birthday when he was three years old.

These two miniatures have been always in the Royal collection, and are well known from the facsimiles published early in the last century with the other works of Holbein in the Royal library.

Of the Lady Audley here represented little is known. The same head occurs in crayon, the flesh only slightly tinted; in the same collection of drawings the dress and ornaments in both are identical.

This portrait, also by Holbein, is of Catherine Howard, the fifth wife of Henry VIII. She was born in 1520, and was executed at Tower-hill in 1542.

The next slide is a fine and not well-known portrait of Queen Elizabeth, taken when first she came to the throne.

It is a most characteristic work of Nicholas Hillyard, the earliest of our native miniature painters, and the real founder of that great school of workers in this branch of art, which has flourished here without rivalry, till the advent of photography extinguished it altogether.

Hillyard was born in Exeter, the capital city of the county which has given birth to so many of our great masters. His father was Richard Hillyard, of that city, and afterwards High Sheriff. Nicholas, his younger son, was born in 1537, and was originally apprenticed to a goldsmith, but he left this trade for miniature painting. At the age of thirteen he painted a miniature of himself, which was formerly in the Harleian Collection, and may be the one still preserved at Welbeck with the rest of that collection. He was appointed goldsmith, carver and limner to Queen Elizabeth, of whom many portraits by him exist in the various great collections of this country. He survived the Queen sixteen years, and till his death in 1619 had the exclusive right of making and engraving all portraits of his Majesty James I. In his treatise on the art of limning he says, "Holbein's manner of limning I have ever imitated and howld it for the best." He painted miniatures with little shadow, and gives in the same treatise the reasons for this practice in a conversation which he had with Queen Elizabeth, where he explained that pictures painted with "grosse shadows"

"Show very well afar off which to limning work needeth not because it is to be veewed of necessity in hand neere the eye. Heer Her Majestie conseved the reason and therefore chose her place to sit in for that purpose in the open ally of a goodly garden, where no tree was neere, nor any shadowe at all.

"This Her Majestie's curious demand hath greatly bettered my judgment, besides divers other like questions in art by Her most excellent Majestie, which to speke or writ of were fitter for some better clarke. This matter only of the light let me perfect, that no wise man longer remain in error of praysing much shadows in pictures which are to be viewed in hand."

The picture now shown may well be the one to which he refers in this short extract from his treatise, for there is certainly no trace of a shadow in it. As might be expected of one who was a goldsmith and jeweller, the objects of jewellery are represented in his work with extraordinary care and precision.

I have included in this series one miniature by a French artist, Francis Clouet, known as Janet, because it is as interesting historically, as it is from its merits as a portrait. This is one of Mary Queen of Scots, taken before her widowhood. It is identified by an entry in the catalogue of the limnings in the collection of Charles I., as "Queen Mary of Scotland," and is fully described among the portraits of His Majesty's progenitors. The dimensions of it are given, three inches by two. It agrees

entirely in feature with the drawings by the artist preserved in Paris, and may be accepted as an undoubted portrait of the Queen, and a standard by which the authenticity of any attributed likeness may be judged.

Following this, I now show another reputed portrait of the same unfortunate Queen. This is from a beautiful specimen of the work of Isaac Oliver, and has been engraved as Mary Queen of Scots, by Houbraken, in his series of Heads of illustrious personages. In workmanship and detail it would be almost impossible to surpass this, but there is no doubt that though the miniature was called Mary more than a century ago, it is quite wrongly so-called. It is more probable that it is the portrait of that Countess of Nottingham, of whom the legend—by no means authenticated—runs that she detained the ring given by Queen Elizabeth to the Earl of Essex, and thereby prevented the stay of his execution.

Of the painter, I now show a portrait painted by himself. This is one of the smallest miniatures I know, and it is a great triumph for this process of reproduction that all its minute details are given with such accuracy—for the oval is not much more than an inch in its widest diameter. Like most artists Oliver was fond of keeping his hand in practice by painting himself, and I have lately seen another, on a larger scale, in the private collection of the Queen of Holland at the Hague.

Oliver was born about 1536. He may have been of French origin, but has always been looked upon as an Englishman. He was pupil of Nicholas Hillyard, and at first always used the same ultramarine background, which had been introduced by Holbein. Later, he relieved his heads against crimson curtains, and occasionally resorted to landscape.

Of this, there is a remarkable example in the portrait of Sir Philip Sidney, one of the most celebrated of all his works. This, formerly in the possession of Dr. Mead, was among the many objects of art which the Royal collection owes to one not generally credited witn so much taste or generosity—Frederick Prince of Wales.

Time does not permit me to give a full account of the life of this painter, or to enumerate even the best of his works—they are to be found by scores in the collections of this country, and they have always been esteemed abroad.

He was much patronised in his time, and painted nearly every one of note. His drawing of Queen Elizabeth for the well-known engraving by Crispin de Pass is preserved at Windsor; but I have not reproduced it here, as it is in pen and bistre, and my principal object has been to show only works in colour.

Henry, Prince of Wales, was a frequent sitter to Oliver, and the picture you now see is one of the finest portraits of that lamented Prince, and one much cherished by his brother Charles, who succeeded to his heritage. It is mentioned in the catalogues of his works of art, and of those of James II., and remained always in the royal collection. It mysteriously disappeared, and was discovered by the late Sir John Cowell, Master of the Household to Queen Victoria, hanging in one of the lodges in the Great Park, whence by his means it was restored to its proper place.

Isaac Oliver's son Peter followed in his father's footsteps, and was, perhaps, even more dexterous. His copies of pictures by Correggio, Titian, and Raphael, which he made for Charles I. from the originals in his gallery at Whitehall, are still preserved at Windsor. He seems to have been regularly employed as Court painter in little during the reigns of James I. and Charles I. The latter monarch he painted often as Prince of Wales and as Sovereign.

The portrait selected for exhibition this evening is one of the earliest, and it may be noticed how closely the features resemble those of his elder brother, which we have just seen. They both inherit from their mother, Anne of Denmark, the peculiarly heavy chin, which in Prince Henry is more pointed, while in Charles I. it is broader, and was so prominent that the King grew the pointed beard with which we all are familiar, to hide what became almost a deformity. This peculiar formation of the jaw may be noticed for many generations in the later Stuarts.

This characteristic feature will be readily discerned in the portrait of the King now produced. This is the work of John Hoskins, a miniaturist of great merit, though, perhaps, surpassed by Peter Oliver, and certainly by his pupil, Samuel Cooper. It has been sometimes asserted that there were two miniature painters of this name, as the letters of the signature J. H. are combined in different ways, but there is no evidence further than this in support of the theory.

Hoskins had two brothers as pupils, Alexander and Samuel Cooper—of the former, the elder brother, not many authentic works

can be identified; of the younger brother, Samuel, there fortunately exist enough to prove how much the glory of English art is due to his genius. Walpole, in continuing the paragraph from which I took the text of this discourse, says: "If his portrait of Cromwell could be so enlarged (that is by a magnifying glass) I don't know but Vandyck would appear less great by comparison." This portrait of Cromwell is now preserved in the magnificent collection of the Duke of Buccleuch, at Montagu-house. Walpole continues: "His works are too many to be enumerated; seven or eight are in Queen Caroline's closet at Kensington; one of them, a head of Monk is capital, but unfinished. Lord Oxford had a head of Archbishop Sheldon"—this last is still preserved in its old filagree frame at Welbeck.

The head of Monk is now shown upon the screen. It deserves, I think, fully as much praise as that bestowed on the head of Cromwell. Most of the portraits of Monk have a coarse expression, like that of a butcher, but beneath the rugged features, Cooper has given to the head a determination and a nobility of character which make this the finest representation of the great General of the Restoration.

The skill of Cooper was confined to the head, his painting of feature and of hair cannot be surpassed; but in the hands and general pose of figure he was never at home.

Of his remarkable power in delineating the head, the present slide is an admirable example. It is the face of James, Duke of Monmouth, natural son of Charles II., and gives exactly that nameless grace which attracted all hearts to this illfated noble in his youth.

Of his father, Charles II., we have here a portrait as flattering as any of that hard featured monarch can be. It is exceedingly delicate in finish, and in this as in all other examples of Cooper's work the masterly treatment of the hair is particularly distinguishable.

Of his brother and successor James II. as Duke of York no finer portrait can be found than this. Regular as it is in feature, and at first sight attractive, it yet on examination betrays all the qualities which history tells us united in this most deservedly unpopular of kings. Arrogance, weakness, cruelty, and sensuality are all portrayed here with a skill as masterly as is the painting of the peruke.

Of the younger sister of the king and the Duke of York, the Princess Elizabeth, who died at Carisbrooke, Cooper has left a pathetic and beautiful picture. She died when 16, but sickness and sorrow have aged her face—the eyes are sunken in their sockets, the nostrils contracted, the lips pinched and pale, the eyelashes and brows have gone, and the figure fallen away. A look of premature old age has so settled upon her features that many will not believe that this can be the face of a young girl, but rather esteem it that of a woman of middle age.

In succession and in contrast with this, we can see the figure of one of the most famous beauties of the voluptuous court of Charles II. This is Frances, "La belle Stewart," of the Grammont Memoirs, who married the Duke of Richmond. Here she is represented in a sort of page's dress, for she was not remarkably particular as to the fashion, quality, or quantity of her raiments. Her face and figure are better and more widely known and circulated than those of any other person. For over two centuries they have been seen on the reverse of the copper coinage of the realm in the figure of Britannia, for which she sat as model.

We shall close the series of the works of Cooper with one of the painter Walker, who so often painted Cromwell. This is not inferior to any of those already exhibited, nor do I know any which is its superior; and being highly finished in every part it shows, in perfection, the great power of this extraordinary man. It is dated in front 1645, and on the back also is scratched by Cooper himself, "Feb. 1644, old stile." This scratching is on the peculiar enamel-like surface, which Cooper used as a ground for his work. Up to this date and till the close of the century, all miniatures were painted in body colour or gouache. It was not till after 1700 that ivory was used. The earliest specimen of its use with which I am acquainted is a portrait of herself by Rosalba Carriera, the well-known pastellist. This she painted in 1704, and greatly excited the admiration of Carlo Maratta, the President of the Academy of St. Luke, at Rome, to which body she was in consequence admitted. This miniature is painted in gouache, except in the face and arms, which are painted in transparent tints to show the texture of the ivory—it remained unknown in a cupboard in Rome, and was only described and photographed within the last few years. A replica of the miniature had long remained unidentified in the Cabinet at Windsor, ever since it came

into the possession of George III. by the purchase of the collection of Consul Smith, of Venice, who was a great friend of the artist.

No account of miniature painting in this country would be complete without a reference to the greatest master of the art in modern times, Richard Cosway. He was a Devonian and was born in 1740. To illustrate the qualities of his work I have had these slides prepared, by which you will be able to see how thoroughly his work deserves the great reputation in which it has always been held.

The first is a small but very delicately finished head of George IV. as Prince Regent. Here, as in all good portraiture from the time of the Greek head artists till now, the treatment of the hair is a sure test of the power of the artist and Cosway is no exception to this rule. He never relied on force or strong contrast of colour, but entirely on the delicate precision of his drawing, which enabled him to seize the features, and to exhibit the character of his sitters. Genuine examples of his work are, as you know, of great value, but he had many pupils, and followers without number, whose works are pretentiously put forward under his name, and with many seriously damage the proper estimate of his place in art. Most of the members of the Royal Family were painted by him, and you may see in this slide how thoroughly he was a master in the art of painting female beauty. This is the Princess Mary, daughter of George III., who married her first cousin, William, second Duke of Gloucester, and who left her well-known house in Piccadilly to the late Duke of Cambridge.

Princess Sophia, her sister, died unmarried in 1848.

Ozias Humphry, also of Devon, was born in 1742. He painted a miniature of Maria, Duchess of Gloucester, in 1769, when she was just thirty years old.

I must ask your kind indulgence for this very imperfect survey of a great subject. It has been in a large measure an experiment, and I regret that the difficulties of reproduction have caused me to omit half a dozen of the slides which had been prepared. The process of reproduction is one that demands the greatest skill and accuracy, and in some cases there has been slight failure. I would not exhibit any but specimens of the highest class, as my object has been to vindicate for miniature painting a larger appreciation and a higher estimate of the place which may be claimed for the masters of the art. Nor would I encumber this paper by biographical or historical detail as I wished the miniatures to speak for themselves.

Till now, no means existed by which this result could be obtained. Made, as Hillyard says, to be viewed in the hand, they could never be placed in comparison with the portraits by the great masters which look down upon us from the walls of national galleries or of the ancestral halls where they themselves worked when they lived; but I hope the time will come when by permanent facsimiles in colour, such as you have seen this evening, they will be admitted to take that place which only their size has debarred them from obtaining already.

DISCUSSION.

Mr. HUMPHREY WARD said that their thanks were due to Mr. Holmes, for having made such admirable use of the magnificent treasure-house of which he was custodian. In every way the paper had been instructive; it had been a lesson in history; it had been a lesson in art; and last, but not least, it had been a lesson in practical science. All sorts of historical considerations must have passed through the minds of the listeners as they contemplated the pathetic features of that unfortunate young man, Henry Prince of Wales, whose early death was perhaps the most important single event that ever occurred in the history of England. If he had lived there might have been no Civil War, and the whole course of our history might have been changed. However, perhaps those were not the primary reflections that should be suggested by a paper on art. One reflection was how admirable were the works of those miniaturists; and he wondered, as he looked at them, whether their perfection, as compared with the work—he would not say of to-day, because he thought the work of to-day was very greatly improving—but the work of yesterday, was not due to the absence of photographic assistance. He was afraid that at the present time a good many miniature painters, instead of making that precise, exact, and penetrating study of the face of their sitter that they saw in Holbein and Cooper, depended far too much on the camera. The camera itself had given them a most admirable lesson that night. If it could speak, he thought it would say, "Leave me alone until after you have finished your miniature, and then I will do everything for you." Thanks to the process in which Sir William Abney and his friends had had so great a share, that wonderful three-colour process, they were able to see miniatures like other pictures translated, and by the aid of the lantern magnified in a way that their fathers, thirty years ago, may have dreamed of, but certainly could not have foreseen. It was now an accomplished fact, and showed what photography could really do to help the

miniature painter; but they must let the photographic work come after and not before.

Mr. HOWARD INCE said that there was one hint which the early miniature painters gave us, and that was the position of the head on the discs in relation to the top of the oval. That might be seen by reference to the portrait of the Duke of Monmouth. In that case the head practically touched the top of the oval. In later instances, and as one got down to modern photography, it would be noticed that the frame got larger and larger, and this happened to the great loss of decorative art.

The CHAIRMAN said that he thought they were greatly indebted to Mr. Holmes for having brought forward this beautiful series of pictures. It was quite impossible for him (the Chairman) to criticise the paper from an artistic point of view. He might be able to criticise it perhaps from the scientific point of view which, in this instance, would be the photographic. The beautiful pictures which had been exhibited had been produced by Mr. Sanger Shepherd's process. Anyone who was acquainted with the work that Mr. Sanger Shepherd had done must know the amount of labour which it cost him to bring the process to such perfection as he had brought it up to the present time. His was not a rule-of-thumb photography. It could not be done by pressing a button and then leaving somebody else to do the rest. It must be a work of extreme accuracy of measurement, and of thought and artistic care. All these points Mr. Sanger Shepherd had devoted to the process, and consequently he had been able to bring a knowledge of the necessities of the case to bear on the reproduction of the miniatures under the supervision of Mr. Holmes, who was a critic of the first order. They might congratulate themselves that the reproduction of miniatures, at all events by three-coloured photography, was an accomplished fact. The gradations which Mr. Holmes had shown on the screen were gradations which were vouched for as true by Mr. Holmes himself. Mr. Holmes had justly valued the reproductions which had been shown, and he had wisely withheld those reproductions which did not satisfy his fastidious eye. If only other people who produced three-coloured photographs would be equally fastidious, and not allow such abominations to appear as were occasionally seen as productions of the three-coloured photography, the three-colour process would not have the bad name which it had at the present time. He would ask the meeting to pass a very hearty vote of thanks to Mr. Holmes for his interesting paper, not only on account of its historical value and its art value, but also for its scientific value.

Mr. HOLMES thanked the meeting for their appreciation. The present paper was entirely an experiment. Some of the slides, which he had shown, he had not seen until that afternoon. What the Chairman had said about the care and trouble which had been bestowed by Mr. Sanger Shepherd upon the pictures was well deserved. The process was, he would not say in its infancy, for it was full grown, but was one which would doubtless develop. He had never seen anything finer than some of the details of the pictures and the way in which the various subtle tones of the miniatures had been reproduced. He did not think that they could have been treated in a better way than they had been. He might state that all of the pictures exhibited were photographed from miniatures which were under his charge in the Royal Library at Windsor. If he was allowed the privilege of addressing the Society on a future occasion he might be able to reproduce some of the fine work which existed in other collections.

In reply to questions from the audience,

Mr. HOLMES said that the carnations and carmines had a tendency to fade. Miniatures were generally kept in the dark as they could not stand much light. Strong sunlight would destroy the carnation colours immediately. Ultramarine would stand even fire. Carmine had a tendency to turn yellow. All the early miniatures were painted with what was called body colour on card. No portrait was painted on ivory until after the year 1700. The first ivory portrait that he knew with a date was about 1704. At that time the ivory was only shown in the flesh tints. The background and all the dresses were still painted in thick body colour.

Miscellaneous.

THE MINERAL WEALTH OF PERU.

In Peru, the main production of silver and copper is obtained at Cerro de Pasco. For several centuries this famous mineral centre overflowed the world with its silver, although the working of the mines was merely superficial, and the system of amalgamation entirely deficient. The depth of the mines very seldom exceeds 150 feet. It is only in recent times that the existence of copper in enormous quantities was discovered at Cerro de Pasco, which has become one of the largest deposits of copper in the world. In the case of gold it is rather difficult to estimate the annual production, as the mine owners do not issue any complete statistics. The mercury or quicksilver of Huancavelica will, it is stated in a recent report by the United States Vice-Consul at Callao, become, in in the near future, a rival of the famous mines of Almaden in Spain, and of New Almaden in California. The exploitation of iron is at present of no great importance in Peru. A considerable quantity of this metal is found at Tambogrande (Piura); also

in the provinces of Colca and Larez. It also exists in various other parts of the country, but no serious attention appears to have been given to the matter as yet. The principal port of the department at Piura, is Paita, and it is said that iron works established there could easily provide all the Pacific coast with as much iron and steel material as at present is drawn from the United States and Europe. The lead mines have not been worked, up to the present, with any profit, but there is said to be an opening here for persons with capital, and well-provided with up-to-date machinery to lessen the cost of production. Sulphur exists in good abundance in all the volcanoes of the Andes, and it presents itself in such dense layers that it is difficult to estimate the quantity that might be extracted, or form an idea of the thickness. It also occurs extensively near the sea, on the Peninsular of Aguja, near Paita. Many varieties of coal are produced in Peru, but as no records are kept, it is not possible to state the exact amount yielded in the country. From a carefully-prepared estimate, however, for a recent year, the amount appears to be about 55,000 tons. Salt is widely distributed in different parts of Peru, although the principal salt pits are on the coast, and are easily and cheaply worked. Owing to the dry atmosphere of the Peruvian coast, different classes of salt have accumulated as well as nitrate. The importation of salt in Peru is absolutely prohibited. The whole coast of the Department of Piura produces petroleum, and that is the only part of Peru in which it is worked.

FRENCH MISSION TO LAKE TCHAD.

Dr. Auguste Chevalier, director of the colonial laboratory at the Paris Natural History Museum, started in May, 1902, at the head of a scientific mission, to Chari and Lake Tchad, to study the native productions, collect specimens, and make topographical observations of the unexplored portions. The Mission passed twenty-two months in Central Africa, traversed more than 20,000 kilométres (12,427 miles) and brought back 150 cases of specimens, without having fired a single shot.

Climbing plants that yield indiarubber abound in the Tchad basin, but the natives do not know how to cultivate them. The Mission discovered several species of dwarf climbers, very numerous in the Snoussi country, that are burnt every year by brush fires, so that they never grow to any great size; but the roots, which yield indiarubber, become, on the contrary, very large.

While the explorers found that cotton could be grown to great advantage, and to a large extent, in the Tchad region and Saras countries, they discovered several magnificent species of wild coffee plant. A giant variety, named *coffea excelsa* by Dr. Chevalier, that grows to an average height of 15 métres (49 ft.), yields excellent coffee.

The Tchad was found to be not a lake but a marsh, invaded by weeds and scattered with inhabited islands, being scarcely ever navigable, while its topography cannot be established because the shores are constantly changing.

Correspondence.

STATISTICS OF THE WORLD'S IRON AND STEEL INDUSTRIES.

May I be permitted to say that so far as I was able to gather the drift of last night's paper, it seemed to me that the main contention put forward by Mr. Digby as to the position of the iron and steel industry being now relatively more satisfactory than in the boom period of 1870-4 because of the cheapening of food supplies and other commodities, is somewhat irrelevant to the consideration of the causes which give rise to anxiety as to the future of our iron trade.

The new light which Mr. Digby appears to think he has thrown upon the question because of the increased purchasing power of a diminishing or stationary export margin, seems, however, to be based upon a misconception resulting from the omission to throw a similar illumination upon the great expansion of the trade of the United States and Germany which would thereby be greatly accentuated.

Thus Mr. Digby's point does not remove the disparity between the tremendous growth of the iron industry in the United States and Germany as compared with its stationary or diminishing character in this country, but so far as it is fairly applicable to a comparison, would probably emphasise such disparity, because the cheapening of commodities has also been very considerable in those countries.

The calculation, though perhaps not necessarily relevant, is interesting, and should desirably be completed, but it is a little unfortunate that what is no doubt a conscientious attempt to remove anxiety as to the future of our great iron and steel industry, by its apparently incomplete and one-sided view, should have somewhat laid Mr. Digby open to the criticism of having discovered a "mare's nest."

GEORGE S. BURT, F.S.S.

4, Lothbury, E.C.,
5th May, 1904.

Obituary.

SIR HENRY STANLEY, G.C.B., D.C.L., LL.D.—Sir Henry Morton Stanley, the great African explorer, whose death occurred at his town residence in Richmond-terrace, Whitehall, at six o'clock, on the morning of Tuesday, 10th inst., had been a life member of the Society of Arts since 1878, when he was elected by the Council "in consideration of the services to

Commerce by his explorations in Africa." He was chairman of the meeting of the Indian Section on May 19th, 1898, when Sir Alfred Lyall read a paper on "Colonies and Chartered Companies," and again, at a meeting of the Colonial Section on January 28th, 1902, when Commander Whitehouse read a paper, "To the Victoria Nyanza by the Uganda Railway." He was also a speaker at other meetings when questions of explorations in Africa and elsewhere were considered. His last appearance at a meeting of the Society was on March 3rd, 1903, when Mr. Herbert Samuel, M.P., read a paper on "The Uganda of To-day," and Sir Henry Stanley then made an important speech.

The particulars of Sir Henry's life and of his public services are so well known, and so fully related by the public press, that it is unnecessary to repeat them here.

MEETINGS OF THE SOCIETY.

INDIAN SECTION.

Afternoons, at 4.30 o'clock :—

TUESDAY, MAY 31.—"The Economic and Industrial Progress and Condition of India." By J. E. O'CONOR, C.I.E., late Director-General of Statistics, India.

APPLIED ART SECTION.

Tuesday evenings, 8 o'clock :—

MAY 17.—"Pewter and the Revival of its Use." By LASENBY LIBERTY. SIR GEORGE BIRDWOOD, K.C.I.E., C.S.I., will preside.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, MAY 16...Optical, 20, Hanover-square, W., 8 p.m. Report of the Optical Standards Committee.

Surveyors, 12, Great George-street, S.W., 8 p.m. Discussion on Mr. Thomas Blashill's paper, "London Streets and Street Traffic."

Geographical, University of London, Burlington-gardens, W., 3 p.m. Annual Meeting.

British Architects, 9, Conduit-street, W., 8 p.m. Rev. J. B. Lock, "The Planning of Collegiate Buildings."

Medical, 11, Chandos-street, W., 8½ p.m. Annual Oration.

TUESDAY, MAY 17...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Applied Art Section.) Mr. Lasenby Liberty, "Pewter, and the Revival of its Use."

Royal Institution, Albemarle-street, W., 5 p.m. Mr. L. Fletcher, "Meteorites." (Lecture III.)

Statistical, 9, Adelphi-terrace, W.C., 5 p.m. Mr. R. J. Thompson, "Local Expenditure and Local Indebtedness in England and Wales."

Pathological, 20 Hanover-square, W., 8½ p.m. Annual Meeting.

Zoological, 3, Hanover-square, W., 8½ p.m. 1. Sir Charles Eliot, "Some Nudibranchs from East Africa and Zanzibar.—Part V." 2. Mr. G. A. Boulenger, "Description of a new Tree-Frog of Genus *Hyla*, from British Guiana, carrying Eggs on the Back." 3. Mr. F. E. Beddard, "Notes upon the Anatomy of certain *Boidæ*."

WEDNESDAY, MAY 18...Meteorological, 70 Victoria-street, S.W., 4½ p.m. 1. Discussion on Mr. W. L. Dallas's paper, "The Variation of the Population of India compared with the Variation of Rainfall, 1891-1901." 2. Hon. F. A. Rollo Russell, "Some of the Causes of Rain." 3. Mr. William C. Nash, "Rainfall at the Royal Observatory, Greenwich, 1815-1903."

Chemical, Burlington-house, W., 5½ p.m. 1. Prof. W. A. Tilden, "Action of Nitrosyl Chloride on Pynene." 2. Messrs. H. J. S. Sand and J. E. Hackford, "The Electrolytic Estimation of Minute Quantities of Arsenic." 3. Mr. C. E. Fawsitt, "The Decomposition of the Alhylureas." A Preliminary Note. 4. Messrs. J. E. Mackenzie and A. F. Joseph, "The Action of Sodium Methoxide and its Homologues on Benzophenone Chloride and Benzal Chloride." Part II. 5. Mr. H. M. Dawson and Miss E. E. Goodson, "The Formation of Periodides in Nitrobenzene Solution." II. "Periodides of the Alkali and Alkaline Earth Metals."

Microscopical, 20, Hanover-square, W., 8 p.m. 1. Mr. E. M. Nelson, "Grayson's Rulings." 2. Mr. C. Beck, "Exhibition of Flower Seeds under Microscopes."

North-East Coast Institute of Engineers and Shipbuilders, Newcastle-on-Tyne, 7½ p.m. Discussion on Engineer-Lieut. E. F. Baker's paper, "The Management of Belleville Boilers at Sea."

Pharmaceutical, 17, Bloomsbury-square, W.C. Annual Meeting.

East India Association, Westminster Palace Hotel, S.W., 4 p.m. Mr. Frank Birdwood, "The Empire's Greatest Commercial Asset."

British Archæological Association, 32, Sackville-street, W., 8 p.m.

Ambidextral Culture Society, 11, Chandos-street, W., 5 p.m. Dr. J. Shaw, "Ambidexterity from the Medical Point of View."

THURSDAY, MAY 19...Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Royal Institution, Albemarle-street, W., 5 p.m. Mr. Arthur Hassall, "Great Britain and Europe" (1763–1793). (Lecture III.)

Electrical Engineers (at the HOUSE OF THE SOCIETY OF ARTS), John-street, Adelphi, W.C., 8 p.m. Discussion on Messrs. Parson, Stoney, and Martin's paper, "The Steam Turbine as applied to Electrical Engineering."

Historical, Clifford's-inn Hall, Fleet-street, E.C., 5 p.m.

Numismatic, 22, Albemarle-street, W., 7 p.m.

Camera Club, Charing-cross-road, W.C., 8½ p.m. Mr. J. D. Rees, "Domestic Life in India."

Mining and Metallurgy, Geological Society's Rooms, Burlington-house, W., 8 p.m. 1. Dr. J. S. Haldane and Mr. R. Arthur Thomas. "Miners' Phthisis—its Causes and Prevention." 2. "Microscopic Demonstration of Ankylostomiasis Ova and Worms, &c."

FRIDAY, MAY 20...Royal Institution, Albemarle-street, W., 9 p.m. Prof. E. Rutherford, "The Radiation and Emanation of Radium."

Quekett Microscopical Club, 20, Hanover-square, W.C., 8 p.m.

SATURDAY, MAY 21...Royal Institution, Albemarle-street, W., 3 p.m. Mr. D. F. Tovey, "Sonata Style and the Sonata Forms," with Musical Illustrations. (Lecture III.)

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ll communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

INDIAN SECTION.

Thursday afternoon, May 12, 1904; The Right Hon. Lord George Hamilton, G.C.S.I., M.P., in the chair. The paper read was "British Grown Tea." By A. G. Stanton.

The paper and report of the discussion will be published in a future number of the *Journal.*

APPLIED ART SECTION.

Tuesday evening, May 17, 1904; Sir George Birdwood, K.C.I.E., C.S.I., in the chair. The paper read was "Pewter and the revival of its use." By Arthur Lasenby Liberty.

The paper and report of the discussion will be published in a future number of the *Journal.*

CASES FOR JOURNAL.

Some members have expressed a desire to be supplied with cases to hold the numbers of the *Journal* as they are issued and before a volume is completed for binding. The binders have prepared and lettered a box in book form (Stone's patent box) to match the cloth-bound volumes of the *Journal,* which will contain all the numbers forming a volume. These boxes can be supplied to members (at a charge of four shillings each) on application to the Secretary.

Proceedings of the Society.

COLONIAL SECTION.

Tuesday afternoon, May 3, 1904; the Hon. Sir John Alexander Cockburn, K.C.M.G., in the chair.

The Secretary of the Section announced that the Earl of Aberdeen (who was to have presided) was unable to be present, his attendance being required in Parliament.

The Chairman said that Englishmen all realised that Canada was the first to demonstrate in the channels of trade the existence of those ties of natural affection to the mother country which might be said to form the key-note of the day; and the author was to be congratulated on the businesslike way in which, as Secretary to the High Commissioner for Canada, that great Britisher whom all loved and admired, Lord Strathcona, he kept the resources of Canada always before the public.

The paper read was—

CANADA AND GREAT BRITAIN.

By W. L. Griffith.

Although facts relating to the great Dominion of Canada and its affairs are in these days being placed before the world in no unstinted quantity, still the deep sympathy which the British public unfailingly manifests towards "The Land of the Maple" has served to modify any diffidence I may feel in venturing to place before the members of this Society a paper on the subject of Canada. It is very satisfactory to observe the steady growth of goodwill between the peoples of Great Britain and Canada. A community of interest is being built up, perhaps more rapidly than is generally appreciated. Business connections and personal friendships have in late years been formed, the full effect of which has not yet been seen. The increase in Anglo-Canadian passenger traffic has been remarkable, and is undoubtedly significant of the formation of international bonds of friendship. It is also gratifying to observe that Canadians visiting this country uniformly speak in very warm terms of the pleasant reception accorded them in the old land; on the other hand, Englishmen who have visited Canada seem to be in

doubt as to which of the two outstanding features of their Canadian tour impressed them most, the vast resources of the Dominion, or the intense kindness meted out to them by their Canadian fellow citizens. The number of Canadians visiting Great Britian has of late years greatly increased. This has perhaps escaped the attention it would otherwise have attracted, from the fact that the Canadians are often confused with our friends from the United States of America. But however this may be, Canadians yearly come on business missions in increasing numbers, and at the same time they generally visit the historic spots in this great Old Country, in which they feel they are entitled to take a pride no less than those born in these islands. I am glad to say that they return to Canada with a much enhanced conception of John Bull's experience, capability and methods. These are some impressions the Canadian business-man who visits England never fails to refer to, and he never forgets the London policeman who regulates the traffic. I might, perhaps, here be permitted to mention some recent conversations I have had with several members of a small colony of young Canadian medical men who are in London pursuing post-graduate studies, in the course of which I was curious enough to ask them why they preferred to make the journey to England when they could so much more conveniently avail themselves of the facilities offered by the great centres of the United States of America. It would not be diplomatic to give the replies in too much detail, but it is, perhaps, sufficient to say that the principles and methods of the medical profession of Great Britain have made a profound impression on the flower of that fraternity in Canada, and students are coming to this country for instruction simply because they believe the masters of the profession here are sound, have a great reverence for human life, and are generally efficient. In these days of alleged British decadency this is cheerful testimony, and I think we may very reasonably hope that the present colony of Canadian medical students in London will steadily continue to increase in numbers and influence. I have heard it suggested that the phenomenal increase in the consumption of Scotch whiskey is attributable to the wide prevalence of Scotch physicians, who are said to commonly advise many of their patients something like this: "I advise you," they say, "to eschew spirits altogether, but if you must take some, let it be a little good Scotch whiskey." Let us hope that the Canadian doctors, now in England, when they return to the Dominion will, be equally effective in helping to perpetuate and strengthen the goodwill which, at present, so happily exists between Great Britain and Canada.

We have been referring to Canadians visiting Great Britain. The number of Englishmen emigrating to Canada is, at present, of course very gratifying. English business-men are also beginning to visit Canada in some numbers in order to spy out the land. This is all very satisfactory as far as it goes, but I cannot help feeling that numbers of Englishmen who have never visited Canada might, with advantage to themselves, when dealing with the annually recurring problem of where to spend their vacations, consider the attractions of a trip to some part of Canada. Take, for instance, that not inconsiderable class—those who desire to seek the haunts of fish and game. They leave England every season for Scandinavia, and Finland and elsewhere. They are willing to pay, and do pay large sums of money for fishing and shooting rights whereby to gratify their favourite pastimes. Yet in Canada, within seven or eight days' journey from Liverpool, is to be found a grand reserve for sportsmen, hundreds of thousands of miles of practically virgin territory, where will be found all the sport that the most ardent can desire. There is an unlimited territory abundantly stocked with game, together with vast expanses of water teeming with fish. If ample time is at the disposal of the sportsman, he can find virgin lands and waters where in seeking for fish or game he will secure such success as perhaps he has never dreamed of. To those whose leisure is more limited, there is a choice of conveniently accessible districts, where most satisfying sport may be indulged in, where trout and salmon can be landed in most gratifying profusion, and where game of many descriptions abound. I will not pursue this feature any further, but proceed to deal with the more serious aspects of our subject.

I have stated that information as to the resources of Canada has been placed before the public during late years in no unstinted quantity. The limits of this paper impose that I shall not enter into too much detail, but with your permission, I should like to set forth some facts as to the recent development in Canada, and her prospects for the near future. Notwithstanding the many and continuous and

ole efforts with which for many years the reat wealth of the Dominion of Canada has een so well placed before this country, there ill remains an unconverted and considerable inority, who are more or less sceptical as to e claims made on behalf of the Dominion in gard to the probable growth of her popula-on in the near future, and in respect to her od-producing capacity.

The other day a letter was shown to me, ritten by a Professor in one of the great nglish universities, a gentleman who is de-rvedly honoured. On perusing this letter I as interested to find that he regarded the orth-west of Canada as an overrated country, nd altogether he took a quite hopeless view of e future of that great territory. I am bound confess that he set forth his case with a ealth of apparently unanswerable conten-ons. He conclusively proved—at least to his wn satisfaction—that it was impossible for anada to become one of the greatest wheat-rowing countries in the world; and that it as very doubtful whether her great prairies ould continue to produce a vigorous and renuous population. I think the effect of at letter upon most persons who had not isited Western Canada would be to create erious doubt as to the much vaunted agricul-ural possibilities of the north-west terri-ries. I will freely admit that as I read the rofessor's letter I began to ask myself whether e impressions I had gathered during a resi-ence of some twenty years in Manitoba were, fter all, correct and sound. But as my mind avelled from the Professor's pessimistic iggestions to a consideration of the progress ctually made in the West, I found it was ossible to demonstrate the inaccuracy of lmost all his contentions by citations of ccomplished facts. I well remember in the ummer of 1881 driving across country from the astern to the western boundary of Manitoba. t that time the province was but sparsely ettled. The settlers had to haul their produce reat distances to market. Their buildings for e most part were primitive in the extreme. and was to be had for the asking, and practi-ally unlimited quantities could have been pur-hased at from 2½ dols. to 3½ dols. (10s. to 14s.) er acre, on easy terms of payment. Two or hree years ago I again covered the same round once more, and found it difficult to alise that it was the same country that I had aversed some twenty years previously. Rail-ays intersected the land in every direction. mall towns had sprung up at short intervals along all the lines of communication, afford-ing profitable and convenient markets for the produce of the settlers. On every hand were the unmistakable evidences of a prosperous community—tiny homesteads now appeared where a few years before had been the log or the sod shanty. The price of land had advanced from, say, three dollars (12s.) an acre to from £3 to £5 an acre, and in some cases to even higher figures. These increased values meant that in addition to making a good living and substantially adding to their working capital, all the early settlers at least had profited to the extent of from £500 to £1,000, according to the size of their holdings. In some instances the results had been more favourable, and in others possibly not quite so good. For instance, I know of one farm which was purchased in 1888 for 720 dols. (£145), and the same place would now bring at least, so I am credibly informed, 15,000 dols. or £3,000. There is no reason to doubt that the lands which are being given away to-day to *bonâ fide* settlers by the Canadian Government, and offered by the Canadian Pacific Railway and the Hudson's Bay Company, and other corpora-tions, at nominal prices, will equally increase in value from precisely the same causes that have affected the lands to which reference has been made.

It is often asked why the growth of Canada's population has not proceeded at a more rapid pace than the official statistics show. Perhaps you will allow me to deal briefly with this point. Until recent years Eastern Canada—which may be roughly termed that portion east of Lake Superior—although possessing immense reserves of timber and minerals, and, in many branches, unrivalled facilities for manu-facturing, was somewhat severely restricted in her outputs by the lack of profitable markets. Her natural outlet (the United States of America) was closed to her by a tariff which—with the exception of the period during which the Reciprocity Treaty was in opera-tion—was practically prohibitive. All this, too, at the time of great expansion in the States, when the dazzling opportunities afforded by that country to all able-bodied Canadians resulted in great migration from the Dominion. If the state of things which existed in Canada at this juncture had remained, the outlook would have been very indifferent and perhaps far from encouraging. But in 1880 the inclusion of the north-west territories in the Confederation of Canada extended her limits

from the Atlantic to the Pacific, and the world is only just now beginning to realise what may be expected in the way of Canadian development, which, with all sincere and due deference to the learned gentleman to whom I have referred, is but in its earliest infancy. In order to cope with the situation created by the present expansion, the manufacturers of Eastern Canada are increasing their facilities for production as rapidly as possible, but even so, are scarcely able to meet the demands made upon them. This being the state of prosperity with Western Canada in its early infancy, it is difficult for even the optimistic to over-gauge the extent of the further progress which will certainly be made in the near future.

It is officially estimated that in Manitoba, Assiniboia, Saskatchewan, and Alberta alone there are, approximately, 171,000,000 acres suitable for profitable farming. Of this vast area only a small fraction is under cultivation. Bearing this fact in mind let us take the case of a single settler locating on the virgin prairie at midsummer, and we find that if he exercises ordinary industry, and if the season be an average one, he will be able with one team of horses or oxen to prepare, say, 40 acres ready for wheat during the first summer. Under average conditions there will be a yield in the following season of, say, 1,000 bushels (125 quarters) of the finest milling wheat in the world. In addition to this, he will probably produce a sufficiency of grain and food for stock, to meet the needs of his homestead. Nine-tenths of his wheat crop he will be in a position to sell. Placing the settler's capital at £100, the proceeds of the first year's wheat crop at an average price—say 60 cents. a bushel—will enable him to realise an amount greater than his working capital. As the result of one year's experience on wild prairie land of a man with but small capital, the contiguous railway is furnished with some 54,000 pounds of wheat freight, and the Canadian manufacturer is called upon to supply at least a plough, a wagon, a binder, and other tools costing about £70; this is, of course, in addition to the ordinary cost of living. I think you will readily admit that this is a very significant showing, and when the vastness of the area is remembered upon which similar results are possible, I do not think it is too much to say that in no part of the globe does there exist, upon such a huge scale, and amid so many advantageous surroundings, equal possibilities for the creation of wealth from the soil.

Professor William Saunders, Director of the Dominion Experimental Farms, in an article on wheat-growing in Canada, makes what he calls a "reasonable prophecy." He says:—

"The total imports of wheat and flour into Great Britain in 1902 were equivalent in all to about 20 million bushels of wheat. Were one-fourth of the land said to be suitable for cultivation in Manitoba and the three provisional territories under crop with wheat annually, and the average production equal to that of Manitoba for the past ten years, the total crop would be over 812 million bushels. This would be ample to supply the home demand for 30 millions of inhabitants (supposing the population of Canada should by that time reach that figure), and meet the present requirements of Great Britain three times over. This estimate deals only with a portion of the West, and it leaves the large Eastern provinces out of consideration altogether. From this it would seem to be quite possible that Canada may be in a position within comparatively few years, after supplying all home demands, to furnish Great Britain with all the wheat and flour she requires, and leave a surplus for export to other countries. With a rural population on the western plains in 1902 of about 400,000, over 67 millions of bushels of wheat were produced. Add to this the wheat grown in Ontario and the other Eastern provinces, and we already have a total of over 93 million bushels. These figures are full of promise for the future of Canada as a great wheat-producing country."

Professor Saunders might be fairly asked where the population is likely to be drawn from to accomplish this stupendous result. The answer is that the people will come chiefly from Europe and the United States of America. I suppose it is true to say that the rapidity and extent of expansion which took place in the United States in the last half of the 19th century has been unequalled in the world's history. This expansion arose from European immigration into the prairies of the Western States. The persons forming that great movement were for the most part those with little or no capital, and yet, as we know, they achieved results which were in the aggregate amazing. This great unprecedented expansion in the United States of America was achieved by poor men, who had to acquire a knowledge of the methods of a land which was new to them, as they went along. I will submit that with the large migration of United States farmers (last year 50,000 of them came to Canada), men with capital, who have developed a country precisely similar to the one they are adopting, flocking into the North-West in ever-increasing numbers, together with the immigration from

Europe, it seems reasonable to hope that we are about to experience an expansion of population and industry in Canada such as shall eclipse even the wonderful progress that has been made in the United States of America.

How fortunate it is that Canada should be so rapidly developing as a great food-supplying country, in view of the probable trend of events in the United States, will, I think, be at once conceded. The population of the United States of America is increasing at the rate of 4,000 daily. It is officially estimated that by 1931 there will be 130,000,000 of people in the Republic. To grow the quantity of produce necessary to sustain this population will require 153,000,000 additional acres under cultivation, and there are, it is estimated, only 108,000,000 acres so available. Moreover, it is very questionable if these can be brought into profitable cultivation in competition with the lands of the Canadian North-West.

In passing it may be well to refer very briefly to the migration of the Western American farmer to Canada. It is a movement which has been encouraged and promoted by the Government of Canada. The American agriculturist is able to sell his farm in the United States of America for from 25 dols. to 125 dols. per acre, and by re-investing in Canada at from 6 dols. an acre upwards is able the better to provide for his family. The preponderating opinion in Canada regarding the matter is extremely optimistic. It is urged that the American is settling in a land where the opportunities for improving his material position are superior to those he has left behind, and this in itself will make powerfully for contentment. While the people of the Republic do not admit that British laws are any better than their own, they do admit the pure judiciary and the firm administration and enforcement of the law in the Dominion. Canadians proudly claim that when the settler from the south crosses the international boundary he leaves behind the revolver. It may well be that the purity of the Canadian judiciary will be the strongest factor making for the continuance of British prestige in North America. It is certain that migration from the United States of America to Canada is bound to continue and expand.

You will readily admit that it is only natural that immigration should be a question of the greatest importance to Canada. Canadians feel that their millions of acres of fertile land now occupied must be settled upon and cultivated, in order to bring about that degree of development which is so confidently looked forward to. You will, no doubt, admit with equal readiness that emigration to the Colonies ought to be a question of the first importance in Great Britain. In the past the surplus population of this country has gone abroad without an effort to divert it to British territory. This state of things has, however, been remedied, and the British emigrant is now provided with reliable and full information in a way that leaves little to be desired.

In 1874, Lord Randolph Churchill, in an election address to the constituency of Woodstock, said:—

"The Colonial Empire of Great Britain, offering as it does, a field of development for the latent energy and labour of the sons of our overburdened island will continually demand the attention of the Legislature. I would support all efforts which would tend to facilitate the means of emigration, and would at the same time strengthen and consolidate the ties which unite the Colonies with the Mother Country."

It would have been extremely interesting to know how far Lord Randolph Churchill was prepared to go in order to facilitate the means of emigration. Would he have supported free passages to the Colonies for the unemployed?

One of the most pathetic figures on earth is that of the man who is willing to work but cannot find employment. Although such persons may form but a small percentage of the population of the United Kingdom, still in the aggregate the number is considerable.

Within the Empire there is ample demand, at good wages, for every able-bodied citizen. It is tragical that while the fertile prairies of the West are crying out for workers, there should be thousands of unemployed, or only partially employed. Fifty years hence our descendants will scornfully dwell upon our timidity and feebleness in dealing with the problem. It ought to be possible for every such man and his family to procure State defrayed transportation to whatever part of the Empire his labour could be profitably utilised, that he desired to go to. The difficulties of carrying this out would no doubt be considerable, but that they are insurmountable I do not believe. There would, of course, need to be a proper system of selection. Let us hope that we may very soon see some efforts made to, as Lord Randolph Churchill has put it, "facilitate the means of emigration."

In the olden days it was considered that wars and plagues were necessary evils, as they prevented an excess of population. To-day a

decreasing birth-rate is pointing to the time when the retention, as far as possible, of every man, woman, and child, within the Empire, shall be deemed desirable, even at the cost of free passages. Australia, it is well known, has suffered a continuous and somewhat alarming falling off in the birth-rate. England, in a lesser degree, is passing through the same experience. For example, in 1866 the birth-rate was 35·8 per thousand; in 1901 it had fallen to 28·5. Realising this, it would seem a wise policy for this country to anticipate events by seriously considering how to "facilitate the means of emigration," and how to retain, as far as practicable, within the boundaries of the Empire every British man and woman.

In the opinion of those who are well qualified to speak, a regular service between British ports by steamers excelling in speed those which now cross the Atlantic, would constitute an important step in the interests of both Great Britain and Canada. For some twenty years past a proposal for the establishment of a fast line of steamers between England and Canada has been under consideration. The Canadian Government has offered a subsidy up to £150,000 per annum, and the British Government have in the past been willing to assist. By an agreement made last year between the British Government and the Cunard Steamship Company, it is provided that the company shall construct, if possible, steamers which shall be capable of maintaining a minimum average ocean speed of 24 to 25 knots an hour in moderate weather. The British Government advance the Cunard Company up to £2,600,000 at $2\frac{3}{4}$ per cent. The justification for a similar concession in order to procure a service between British ports seems equally strong. The distance between Liverpool and a Canadian port—say Halifax—is 2,465 miles. Therefore, a vessel with a speed of twenty-five knots an hour would make the journey in a little over four days from port to port. From Galway to Halifax is 2,160 miles, and the same vessel could accomplish this journey in a little over three days and a half.

As you all know, the Atlantic passenger traffic has increased by leaps and bounds, and this increase is likely to be at least maintained. A very considerable proportion of these passengers is affected by sea sickness, and it may be fairly assumed that a majority of them would travel by a route which afforded a very considerable curtailment of misery. Then there would be business people to whom time was all important, and altogether it may be assumed that with such a line of boats as has been indicated, a traffic—passenger and freight—would cross by the Canadian route, such as would, having regard for all the circumstances, be of incalculable value to British interests, and would put our alternative route to the East on a thoroughly satisfactory basis. When this proposed Canadian fast line does become an accomplished fact, let us hope that in each vessel a certain amount of passenger space will be available free to State-selected emigrants who desire to transfer themselves from the congested centres of England to the healthy life of the open prairie.

I have referred, in the earlier portion of my paper, to the growing goodwill which so happily exists between this country and the Dominion. But while this is true, it is also equally true that, in the opinion of leading Canadian statesmen, there are vital matters of high politics which require friendly adjustment. This became manifest in the announcement of the decision of the Alaska Boundary Tribunal last autumn. Canada, as we know, was sorely disappointed thereat; and while, I think, we may hope that the feeling of soreness is passing away, there is no doubt that that decision was responsible for bringing to the fore important questions as between Great Britain and Canada. When a discussion took place in the Canadian House of Commons on the Alaska boundary award, Sir Wilfrid Laurier, the Premier of Canada, said:—

"I have often regretted also that we have not in our own hands the treaty-making powers which would enable us to dispose of our own affairs. But in this matter we were dealing with a position that was forced upon us—we have not the treaty-making power. I am sorry to say that the whole correspondence which we have had upon this question since 1899 has not yet been placed before Parliament; I am sorry not only that we have not the treaty-making power, but that we are not in such an independent position that it is in my power to place before Parliament the whole of the correspondence as it passed between the Canadian Government and the British Government. But we shall have that correspondence, and it will be placed before Parliament at the next Session—the whole of it, no matter what protest may come from abroad, we shall have the whole of it, and then this country may know exactly what has taken place, and what share of responsibility must rest upon each of the parties concerned in this matter. But we have no such power, our hands are tied to a large extent owing to the fact of our connection—which has its benefits but which has also its disadvantages—the fact of our connection with the Mother Country

making us not free agents and obliging us to deal with questions affecting ourselves through the instrumentality of the British Ambassador."

Subsequently, in an interview accorded to Mr. H. W. Lucy, and printed in a London newspaper, Sir Wilfrid Laurier said:—

"The Dominion is unanimous in demanding that a repetition of the Alaska Boundary incident should be rendered impossible, by having ceded to Canada the right of making her own Treaties with Foreign Powers."

The interview goes on as follows:—

"I ventured to point out the obvious fact that such condition of affairs is inconsistent with Colonial status, and implies separation. Denying this, Sir Wilfrid explained in detail what was in his mind when, shortly after the promulgation of the judgment in the Alaska Boundary case, he fluttered diplomatic dovecotes by insisting on this new departure. He is careful to point out that it is not absolute power of treaty-making that the Dominion demands. Treaties will still be subject to the veto of the Sovereign, and if such veto be decreed, there is an end of the matter.

"But Canada, he insists, must be permitted to arrange the preliminaries of all treaties affecting her trade and territory, leaving to the Sovereign the responsibility of vetoing the proposed arrangement, should he, acting on the advice of his Ministers, think it desirable in the interests of the Empire. Had Canada possessed such power prior to the constitution of the Court on the Alaskan Boundary, the inquiry would never have taken place with the collaboration of the three gentlemen who pleaded the cause of the United States before Lord Alverstone.

"Sir Wilfrid points out that there is nothing new in his demand. It is merely the resuscitation of an old cry. Twenty-one years ago, when Mr. Blake, now representing an Irish constituency at Westminster, was leader of the Liberal Party in the Dominion Parliament, he moved a resolution embodying the demand made by Sir Wilfrid when news reached Canada that all had been lost in the Court sitting in London. 'Nothing came of it then,' I observed. But something will come of it now, Sir Wilfrid positively affirmed. Canada is mightier, more populous by far than she was in 1888. There are to-day nearly six millions of people who believe with passionate conviction that they have the right to determine the course of matters relating to their commerce and their boundaries. However, we have convincing proof that the existing custom is persistently, fatally hostile to Canadian interests. In 1888 the question arose in connection with the Alabama claims. By the Fenian raid, organised and launched from the United States, Canada suffered more than did America from the depredations of the *Alabama*. Our Government of that day besought the Imperial Government to insert in the Washington Treaty a claim that would have brought the Canadian claims under purview of the Court. England, afraid of offending the United States, turned a deaf ear to the plea, leaving her Colonies in the lurch. Much the same thing happened in respect of the boundary of Alaska. As I have said, had we had the power to arrange the preliminaries of inquiry with the United States, we should at once have put our foot down in protest against the appointment of three partisans to serve in the capacity of jurists, and the result of the inquiry would have been very different."

It does not appear from Sir Wilfrid Laurier's attitude that it is one Englishmen need be at all alarmed at. So recently as during the Governor-Generalship of Lord Dufferin, a Liberal Minister — Lord Kimberley — advised Lord Dufferin that it was not necessary for him to consult his Ministers except when it suited his purpose to do so. It was about this time when the Hon. Edward Blake, who was Minister of Justice, made a report upon which the Governor-General's instructions were amended. In regard to capital cases clemency was at one time vested in the Governor-General, but this power was taken away and vested in the Executive. From time to time, in a variety of ways, the British Government has been strengthening the powers of the Canadian Government. Recognition has also been accorded the Dominion in the negotiation of all Treaties in which she was concerned. Increased freedom has undoubtedly made for increased goodwill. There is no proposal for separation, as some have attempted to prove, but simply for a reasonable extension of local autonomy. In the light of past experience there is no reason to fear that anything but good will ensue from compliance with every reasonable request from a people of devoted loyalty and friendliness to your own.

A factor which is lending strength to Canada's request for treaty-making power, subject to the King, may be found in a retrospect of British diplomacy as it has affected Canada since 1878. Mr. T. Hodgins, K.C., of Toronto, has been putting this very ably before his countrymen. In an article published some time ago in the *Contemporary Review*, he writes:—

"The diplomatic disasters through which Canada has lost some of the best agricultural portions of her original heritage explain why Canadians now look with intense anxiety for the just settlement of the Alaska Boundary controversy; for, as has been said by Sir Charles Dilke in his 'Problems of Greater Britain,' it is a fact that British diplomacy has cost Canada dear."

In conclusion, I sincerely thank you for the patience with which you have listened to me. I have endeavoured during such odd moments as were at my disposal to deal with a few features of a country where I spent the most joyous years of my life, and if this paper shall have served to arouse any interest in it I shall feel amply repaid.

DISCUSSION.

The CHAIRMAN said that all who had been in Canada would be able to bear out the fact that the author had in no way exaggerated the enormous resources of that vast portion of the British Empire. But, unfortunately, all had not been to Canada, although, if the outline of the future with regard to rapid transit which Mr. Griffith had sketched was carried out, a trip to Canada would soon be little more than a week-end matter. He thought that those who were engaged in public affairs at the heart of the Empire could hardly be expected to perform their duties properly unless they made themselves personally acquainted with such a very closely adjoining portion of the British dominions. There was no doubt whatever about the enormous capacity of Canada in the supply of food for the Empire, and they all admired the artistic and thorough manner in which the author had demolished the pessimistic professor he had referred to. There were croakers everywhere who always decried everything which lay in the future, but the development of the Empire went on and made very short work of such forebodings. He had listened with great interest to the portion of the paper which dealt with emigration. There was no doubt England had been prodigal in past years in the manner in which she had poured out the greatest treasure which any Empire could possess. There had been a constant outflow of her sons and daughters which had been allowed to be diverted to foreign soil. The *laissez faire* regime of the past was hostile to anything like systematic emigration; but that age had passed away, in fact its passing bell was tolled in that very chamber a little while ago by the statesmen of both parties, who met together and discussed the question of cotton-growing within the Empire. It was agreed on all hands that the time of letting things alone had gone by, and it was necessary for all to join hands and take hold of great imperial problems, and bring their intelligence and will to bear on their solution. That was being done, not only by the Canadian Office and by Mr. Griffith personally, but by numerous emigration agencies, which carried out the work of systematic emigration in a surprisingly complete manner. The path of the intending emigrant was smoothed, and his, and, he might say, her way, made easy, for there was a very considerable number of women emigrants going out from the Mother Country. That was a necessity of the day because although there was a preponderance of women population in Great Britain, there was a comparative deficiency in the outlying parts of the British dominions. Canada herself was deficient in that respect, and required many thousands of women to provide helpmeets and better-halves for each of the males who was settled in Canada. Good wine needed no bush, and Canada really required no advocacy from anyone, so far as its merits were concerned, but as everybody had not been there it was necessary for those who had a long experience, such as the author, to hold up the attractive picture before the eyes of the public. That Mr. Griffith had done in a very businesslike and excellent way, and he was sure all heartily congratulated him on the paper, which would greatly assist in the work he was doing in keeping before the eyes of the Mother Country and the world the wonderful capacities of the granary of the Empire.

Mr. JOSEPH WALTON, M.P., thought there was no one who could speak on such an important subject with greater knowledge and authority than the author. He (the speaker) had had the pleasure of learning something of Canada. In 1890 he leisurely travelled through Canada from the Atlantic to the Pacific Ocean; he repeated the journey in 1899, and, in the autumn of last year, he had the opportunity of attending the Congress of Chambers of Commerce of the Empire in Canada, and of travelling some 4,000 miles round the maritime provinces. In 1899 he was wonderfully impressed with the marvellous development that had been made in the previous nine years, but last year he was still more profoundly impressed by the still more rapid increase which had taken place in the development of the country and its industrial progress during the four years since his previous visit. He learnt that the commerce of Canada, in the four years ending last year, had increased more than in the preceding 20 years. There was no question as to the accuracy of the statements with regard to the marvellous resources of the great Canadian dependency. It was an object-lesson when one learnt that American farmers, to the number of about 50,000, had so realised the advantages which Canada offered agriculturally, that they had crossed over from the United States and settled themselves on the prairies of Canada. It was certain that on the virgin prairies of Canada, on which wheat could be grown for a generation without putting any manure into the land, that even at the present low prices wheat could be grown in Canada, and sent to this country at a handsome profit; and when one knew that 163 acres of land in the Far West would be transferred to any respectable emigrant over 21 years of age, at a cost of £2 only, he submitted it gave an opportunity to the industrious working men at home who had saved a little money to better themselves, and have a more prosperous future than in almost any other part of the British Empire. He deeply regretted that Canada was in danger of becoming Americanised. He would infinitely rather that the emigrants from this country

went to settle in Canada and elsewhere in the British Empire than in the United States or other foreign countries. All that was needed to secure that end was, he believed, that greater and more widespread knowledge of the enormous advantages and possibilities of the country should be circulated. His remarks applied not only to agriculture, but to the lumber industry. Lumber lands were being acquired by syndicates of United States capitalists, while they were practically unnoticed by British capitalists. In various industries, too, the moment the cute Yankee realised that there was a sufficient demand in Canada for a particular product, he immediately crossed over and established works in competition with English capitalists, and with the Canadians themselves. There were so many openings for the profitable investment of capital in Canada, that he thought it was of the highest importance they should be brought more prominently before the investing public in this country. There was fruit cultivation, both in the maritime provinces and on the West Pacific Coast, which, when properly conducted, was found to be most prosperous. In the autumn of last year, when delegates went over to the Congress of Chambers of Commerce of the Empire, they had a magnificent demonstration of the enthusiastic loyalty of the Canadian people to the British Empire. They went there to study how they could strengthen the commercial relations and increase the trade between the Mother Country and Canada. He was bound to confess that the present trade relations were not satisfactory. England took from Canada 23 million pounds a year of produce and goods, and did not tax them a single penny, but unfortunately Canada still taxed the 10 million pounds worth of goods England sent to the tune of two millions a year. He hardly called that reciprocity or fair trade, and, though England was grateful to them for the one-third rebate off their import duty, it hoped that in the near future Canada would feel itself able to make a substantially greater rebate. Then in the matter of imperial defence, England was spending 66 million pounds this year, or £1 12s. per head of the whole population; and beyond bearing the cost of their own militia, although the five million inhabitants of Canada enjoyed the benefit of that expenditure on imperial defence, he was sorry to say they did not give us any further contribution. Lord Brassey would be able to bear him out that there was a strong body of opinion in Canada that a reasonable contribution ought to be made. At the present moment Canada had infinitely the best of it so far as the trading were concerned, and in the matter of imperial defence, she received what might be regarded as a preferential tariff. With regard to the development of Canada, he suggested when he was out there that Canada should be ambitious enough to run a British Empire Exhibition five or six years hence. Canada was so prosperous when he was there that she had 13 million of dollars surplus in the exchequer, and the country was developing rapidly. A British Empire Exhibition, with a fast line of steamers previously established between England and Canada, would do more for the development of trade between the two countries than possibly anything else. Personally, he would infinitely rather that the British Government gave a substantial subsidy to a fast line of steamers between England and Canada than that they should have given the subsidy they had to the Cunard Company to run steamers to American ports; and he hoped some change in that direction would take place. With regard to the Canadian bounty system, they had heard how the bounty system had strangled the sugar trade in the West Indies, but the proceedings that were taken to put a stop to it had not been altogether successful. He was sorry to find that last year additional bounty Bills were passed through the Canadian Parliament. He thought a 20 per cent. duty was quite a sufficient drawback against English manufacturers in competition with enterprising Canadian manufacturers, but when he learnt that the iron and steel manufactures of Canada would probably get two million of dollars bounty this year, he felt that that was a still further handicap which they would be glad to have removed. He believed in all fiscal matters being absolutely left in the hands of the Canadian Government; England preserved her right to make her own fiscal system, and Canada enjoyed the equal privilege of making her's; and, therefore, it was only by friendly reasoning, and by a consideration of all the *pros* and *cons*, that he thought relations might be arrived at which would be still more likely to promote increase of commerce between Canada and the Mother Country.

Lord BRASSEY, K.C.B., said that having had a long, personal, and hereditary connection with Canada, he always endeavoured to be present on any occasion when the interests of Canada were under review, and by his presence to show his sympathy with and his earnest desire for the advancement of that great territory. The author had referred to Canada's growing prosperity. He could say something on the subject from personal experience. Many years ago, for a purely philanthropic purpose, he acquired a considerable holding of land in the vicinity of Indian-head and Qu-appelle Railway Stations. He sent out several hundreds of emigrants, and undertook farming on a large scale. For many years he failed to find purchasers for the land which he desired to dispose of, but that difficulty, he was happy to say, had now been entirely removed. It did not command the prices to which Mr. Griffith had referred, but he believed he was gradually liquidating the situation, although he did not charge interest on a long lock-up. His emigrants had flourished as fully as he could have wished, but not in his employ. The scheme did not provide as fully as might have been desired for the conditions which obtained in Canada, and his emigrants arriving in the piping times of Canadian harvest, found they could do at that moment better

elsewhere. He was glad to say that every one of them whose career he had been able to trace had succeeded, and, therefore, from a philanthropic point of view, the experiment left nothing to be desired. Farming was not altogether a success with him, but when the farmer was living in London and the farm was in the Far West of Canada the conditions could not be regarded as ideal. Not long ago he paid a visit to the locality, and found quite a number of people working on various scales as regards extent of holding, and was delighted to hear from everyone of them a cheerful tale. He was, therefore, able to bear out all the author had said with regard to the agricultural prosperity of Canada. Mr. Griffith referred to a rather difficult question, namely, the treaty-making power of Canada. England must be prepared to find, as the States of the Dominion increased in population and resources, and in all that constituted the greatness of the country, that Canada would desire that England should have less control over her local affairs. That would not imply less love for the Mother Country, or less determination to rally round the old flag when contingencies arose which called for the display of loyal sentiment. He believed the sentiment of Canada was voiced in the lines of the poet, which he remembered were quoted by Sir Wilfrid Laurier, in a speech delivered at Liverpool on one of the occasions when he was bidding farewell to England after a visit here :

> "Daughter am I in my mother's house,
> But mistress in my own."

He did not apprehend that evil consequences would arise, such as they might deprecate, from a concession in the sense which he assumed was recommended by Sir Wilfrid Laurier. If the views to which Sir Wilfrid had been giving expression were accepted by the Government of the Mother Land, then it would follow that in treaties which mainly affected the local interests of Canada, the initial step would be taken by the responsible Ministers of Canada, and when they had advanced far enough in the negotiations, the matter must come before the Home Government. Any agreement would require the assent of the Crown, which would be given upon the advice of the constitutional advisers; and, therefore, in the second stage and not in the first, the responsible Ministers of the Crown at home would have a controlling voice in the policy of the Empire, even when the matters under treatment were essentially those of the local interests of one of the dependencies. Mr. Griffith spoke of more rapid steam communication between England and Canada, to the importance of which he (Lord Brassey) most heartily subscribed. He believed it would be a matter of wise policy on the part of the Government at home to be very liberal in the subsidy to a Canadian ocean mail service. Swift communication was one of the bonds of Empire, and he looked upon the proposal favourably from that point of view. He also regarded the establishment of such a line as valuable for the purpose of training officers and men as naval reservists. It was qu[ite] clear that the establishment of such a servi[ce] would involve the building and maintenance [in] efficient working order of a number of vess[els] which would, under certain circumstances, [be] valuable from a naval point of view as t[he] eyes of the fleet. He, therefore, hoped that t[he] proposal would receive careful consideration. [He] was one of the tens of thousands in this country w[ho] had a warm regard for Canada, and he hoped th[at] that great colony might ever flourish.

Mr. W. T. R. Preston (Canadian Commission[er] of Emigration) thanked Mr. Walton for his present[a]tion of certain views which occurred to him durin[g] his visit to Canada. He was sorry, however, th[at] while an annual interest was taken in Canada by som[e] of the great societies no result apparently seemed [to] follow from the meetings. The paper was full of in[-]formation for the consideration of the British publ[ic] in respect to the colonies. A great many papers aft[er] they were read were consigned to oblivion, but h[e] thought there was a sufficient audience present wh[o] would very gladly meet together for the purpose [of] finding a solution, from the British standpoint, [of] some of the questions which the author had pre[-]sented. He could not altogether agree with the pro[-]position that State-aided emigration would be wis[e]. He agreed that there ought to be some kind of aide[d] emigration in dealing with the congested populatio[n] of this country, where there were so many who wer[e] crying out for work, who were anxious to do anythin[g] by which they might earn a competence for them[-]selves and their families and for whom no avenu[e] seemed to be open. It might be said, why did no[t] the Government provide some channel whereby tha[t] population could be transported to some place wher[e] they could get a living and provide an independence fo[r] their families? There were political aspects whic[h] made it a question of rather serious import. He di[d] not know enough about British politics to speal[k] definitely on the point, but the contingency wa[s] not improbable, that if there was State-aide[d] emigration to Canada candidates might go t[o] the constituents and intimate to voters that i[f] they voted on certain lines they would be assisted to get to a country where they might fin[d] for themselves a competence which they coul[d] not find at home; and such a thing might tak[e] place in Canada as candidates for Parliamen[t] suggesting to voters that they would not be asked to return the money if they voted the righ[t] way. He did not believe in any kind of aided emigration which made an emigrant absolutely dependent. He hoped to see something of the kind carried through, but upon a broad and really solid financial and business basis, so that any money advanced should be returned by the emigrant to whom the favour had been granted. It was desirable to have a certain independent spirit which should be maintained all through one's life. He

knew something about the working of great organisations in Europe, which, he thought, speaking to a Christian audience, ought to teach them many a lesson. He referred to the distribution of the funds of the late Baron Hirsch, by means of which there were gathered together Jews throughout the whole world who could not support themselves, who were assisted in emigrating to the various countries where they might obtain a living and an independence for themselves and their families. He frequently told the managers of that institution that they were making a huge mistake, because they were making those whom they were assisting entirely dependent instead of independent. Something upon the line of Government assistance, but upon a business basis, would, he believed, result in enormous good to this country, and would assist in maintaining a vast population which, in a generation or two, would be a source of strength and influence to the Empire, which this Empire sadly needed. England stood to-day in her magnificent isolation, with the prospect of having all the world against her. It had been so before; it might be so again. England was the only great nation of the world taking little or no interest in the movement of her population. France, Germany, Austria, Hungary, Norway, Sweden, Denmark, and Russia did something towards diverting the stream of their surplus population to countries where, perhaps, as statesmen viewed the future, they might give them less trouble than if they went to others; and yet this country, requiring, as it must require in the future as in the past, the moral as well as the material support of the colonies, was not doing so to the extent that the importance of the subject demanded. The time would come when statesmen must face the question, and thus try to retain our people within our own boundaries.

Mr. HAMAR GREENWOOD said he was particularly pleased with that part of Mr. Griffith's excellent paper which referred to treaty-making powers. It indicated the gross ignorance of the Canadian national spirit when people alleged that the demand for treaty-making powers necessitated separation from the Mother Country. No such thing, to his mind, was ever intended by Sir Wilfrid Laurier, or by any other reasonable Canadian; but he was certain that six millions of democratic people living together resented too much mollycoddling from any headquarters. The national spirit of the Canadians was but a commendable evolution of those instincts which were strongest and best in the British breast. He hoped that the Canadians would have treaty-making powers. Any measures passed by the Canadian Government must, of course, be subject to review by the Government of the day sitting at Westminster, and he trusted that no generation of Canadians would ever arise who would wish to insist upon a treaty or upon a policy that would in any way militate against the general well-being of the Empire. Canadian loyalty was a true loyalty to Canada and the Empire; but with the growth of their national spirit he insisted that they should have a growth of their local powers, and that did not mean any disloyalty to the dear old Mother land. He thanked the author for his admirable paper, which he had thoroughly enjoyed, and which he hoped would do something to dissipate the ignorance which was still prevalent in this country. As one who took some part in public life he had himself been called an alien, a foreigner, and a Yankee, and certain political opponents of his went so far as to say that they hoped the present Aliens' Bill now being considered by the Government would not only include gentlemen like himself, but would deport them! He hoped the time would come when every Englishman would realise that a Canadian was as much a Britisher as he or she who was born in London, even within the sacred parish of Westminster. He hoped also they would realise that when a man intended to leave the homeland he should not forget his obligations to his race, but endeavour to settle in some portion of the British Empire, where he, and those who were born unto him, might uphold the splendid traditions of the great Empire.

Miss WEBSTER wished to call attention to one of the author's statements which was not much thought of in England, namely, the great disadvantage of so many American settlers coming into the North-West of Canada. The American settlers were imbued with the same love of their motherland as Englishmen, and were trying everything they could locally to disseminate their influence, and to induce the Canadians to agitate for an annexation to the United States. That feeling was much more prevalent in the North-West than it was in Central or Eastern Canada, and she was very much astonished at it when she visited several farmhouses in that neighbourhood, two years ago, almost before the great American exodus occurred. From letters from her correspondents she gathered that there was quite a propaganda in some districts to induce people to believe that they would be able to obtain a much greater amount of money from Americans and American capitalists if they became citizens of the United States of America. Originally many people in Vancouver who were not British settlers came from Oregon. She noticed with pride that the author had said that many Canadian doctors studied in England. After being in the States for some considerable time she found there that although Americans thought a very great deal of McGill College, Montreal, no American in America put the slightest confidence in either English or Scotch medical men; in fact, she knew of several instances where English doctors, after struggling there for some years, had been obliged to return to England. She also wished to ask why it was that so many English settlers did not remain in Canada. During the last decade or longer settlers had gone out there, and had found that the work in Canadian farmhouses, both for men and women, was

far harder than it was in England. Although she came from a Lincolnshire farming family, she had no idea what work could be from early morning till late at night until she stayed in a Canadian farmhouse. It was also the case with citizens that the hours of work were longer, and both in Canada and the United States, workmen tried to turn out more work in the time than their fellows; those that were slowest being the first to be discharged when work became less urgent.

Mr. GRIFFITH, in reply, said the Chairman referred to the desirability of more women emigrating to Canada. He had always observed that in Canada one could talk with the grandchildren of a man or a woman who came from Ireland or Great Britain, and speak to them about a particular place in the old country, and could draw tears to the eyes of the boy or girl, although they had never been to the country. It was a most extraordinary thing, because he did not think the treatment of the ancestry of the person affected in that way was any better than it ought to have been. Notwithstanding all that, the love for their old country was remarkable, and was not to be traced to the great constitutional powers of government, which some complacent Englishmen referred to as the solution of a case of that sort. He thought that that spirit was due to women entirely; they had loved the old country, they remembered the old spot they once lived in, they did not leave willingly (in the old days, at any rate), and when they settled in the new country, they taught their children about the land they loved so well. That had been transmitted down from generation to generation, and the wonderful good feeling which existed in the colony towards England could in that manner be traced to the women. The Chairman had referred to the part which he (Mr. Griffith) had taken in advertising Canada in this country. He must protest, because the Chairman had done him too much honour; he thought that to Lord Strathcona and, in the next place, perhaps, to Mr. Preston was chiefly due the very able way in which the claims of Canada had been placed before the country. Mr. Walton was very much afraid that Canada would become Americanised. He thought the fact that the Canadian Government was encouraging American immigration ought to do a great deal to dissipate any fear. There was also the fact that the American came to a country in which there were chances for improving his material position; he also found that the laws were administered better than the laws of the country which he had left. Every factor made for contentment. He might point to a concrete case to prove what he had said. He believed that a large proportion of those who controlled the great lumber industry of Canada came originally from the United States of America, and there were no more contented or desirable class of citizens in the Dominion than these very people. Everybody had been interested in what Lord Brassey had said, particularly in regard to a fast line of steamers. He thought his Lordship's testimony in that respect was particularly valuable, especially coming as it did from one who might be regarded as an expert. Mr. Preston had taken partial exception to the very general proposals he made in regard to State-defrayed emigration. He only raised the question in a very general way, the ground he took being the humane ground; as to the details, no doubt they would have to be dealt with with considerable care. He thanked Mr. Hamar Greenwood for the kind remarks he made, and hoped he would be spared for many years, to place before the British public the oratory of Canada. Miss Webster was very much afraid that Canada would become Americanised, but he thought the remarks he had made in regard to Mr. Walton's contentions would answer what she said on that head. She also referred to the hard work on the Canadian farms. He had some experience of Canadian farms, and confessed that the work was hard; anybody who went out to a Canadian farm expecting there would not be hard work would be very much disappointed.

On the motion of the CHAIRMAN, a vote of thanks was unanimously accorded to Mr. Griffith for his paper.

Correspondence.

STATISTICS OF IRON AND STEEL INDUSTRIES.

In summarising my paper, Mr. Burt, I think scarcely does me justice. He wrote on May 5th after hearing my paper read on the 4th. Had he awaited the issue of the *Journal* on the 6th, and read it in its entirety, he would, perhaps, have gathered that in no way do I minimise the tremendous growth of export trade in the United States and Germany. I do not claim that, as a whole, the position of the iron and steel industry is more satisfactory than in 1870-4, because of the cheapening of food supplies, but I do claim that the margin between imports and exports in the 1898-1903, as compared with the 1868-72, quinquennium, is satisfactory when that margin is measured in its food-purchasing value. Before a definite verdict can be pronounced, the internal consumption must be determined.

In my detailed tables, page 553 (which were not quoted at the meeting), I have fully emphasised the tremendous growth of the margin between exports and imports in Germany and America, both in percentages of the output of each country in 1893-97, and in percentages of the British output in that period.

Mr. Burt urges that I ought to have converted these margins into their purchasing equivalents, forgetting that for only 22 years has Germany had such

margin, and the United States only for seven years. Besides, while part of the British exports are exchanged against food stuffs, America only barters her iron and steel wares for tropic foods, manufactured articles, and general luxuries. Germany also does not exchange proportionately so large a volume of her commerce for food as the United Kingdom. For these reasons the margin given in its food-purchasing value would be misleading for these countries, even could a 35 years' curve be prepared. If Mr. Burt had awaited the publication of the *Journal*, or, better still, had spoken from his place at the meeting, he might, had he then employed the illustration with which he concludes his communication, have suggested, as I suggest now, that the discoverer of the mare's nest was not the writer of the paper, but that the announcement of the *lusus naturæ* was due to Mr. Burt's misapprehension of the contents of the paper.

W. POLLARD DIGBY.

Trafalgar Buildings,
Charing Cross, London, W.C.
May 16th, 1904.

THE LIBRARY.

The following books have been presented to the Library since the last announcement:—

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MEETINGS FOR THE ENSUING WEEK.

TUESDAY, MAY 24...Royal Institution, Albemarle-street, W., 5 p.m. Mr. H. F. Newall, "The Solar Corona." (Lecture I.)

Anthropological, 3, Hanover-square, W., 8½ p.m.

Linnean, Burlington-house, W., 3 p.m. Annual Meeting.

WEDNESDAY, MAY 25...Geological, Burlington-house, W., 8 p.m.

Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p.m. Mr. W. H. Hudleston, "The Tanganyika Problem."

United Service Institution, Whitehall, S.W., 3½ p.m Rev. T. J. Lawrence, "Problems of Neutrality—Illustrated by the Russo-Japanese War."

Royal Society of Literature, 20, Hanover square, W., 8½ p.m.

British Astronomical, Sion College, Victoria-embankment, E.C., 5 p.m.

THURSDAY, MAY 26...Royal Institution, Albemarle-street, W., 5 p.m. Mr. H. G. Wells, "Literature and the State." (Lecture I.)

Electrical Engineers (at the HOUSE OF THE SOCIETY OF ARTS), John-street, Adelphi, W.C., 8 p.m. Mr. Alexander Siemens, "High Speed Electric Railway Experiments on the Marienfelde-Zossen Line."

FRIDAY, MAY 27...Royal Institution, Albemarle-street, W., 9 p.m. The Prince of Monaco, "The Progress of Oceonography."

Physical, Royal College of Science, South Kensington, S.W., 5 p.m. 1. Dr. C. Chree, "The Law of Action between Magnets." 2. Prof. J. Larmor "The ascertained Absence of Effects of Motion through the Ether." 3. Dr. P. E. Shaw and Mr. C. A. B. Garrett, "Coherence and Recoherence."

SATURDAY, MAY 28...Royal Institution, Albemarle-street, W., 3 p.m. Sir William Martin Conway, "Spitzbergen in the 17th century." (Lecture I.)

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FRIDAY, MAY 27, 1904.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

NEXT WEEK.

Tuesday, May 31, 4.30 p.m. (Indian Section.) J. E. O'Conor, C.I.E., late Director-General of Statistics, India, "The Economic and Industrial Progress and Condition of India."

CONVERSAZIONE.

The Society's Conversazione will take place at the Royal Botanic Gardens, Regent's-park, on Monday evening, June 27th, from 9 to 12 p.m.

The programme of arrangements will be announced later.

Each member is entitled to a card for himself (which will not be transferable), and a card for a lady. These cards will be forwarded in due course. No application for them is required. In addition to this, a limited number of tickets will be sold to members of the Society, or to persons introduced by a member, at the price of 5s. each, if purchased before the date of the Conversazione. On that day the price will be raised to 7s. 6d.

Members can purchase these additional tickets by personal application, or by letter addressed to the Secretary. In all cases of application by letter a remittance must be enclosed. Each ticket will admit one person, either lady or gentleman.

Tickets will also be supplied to non-members on presentation of a letter of introduction from a member.

Light refreshments (tea, coffee, ices, claret cup, &c.) will be supplied.

Proceedings of the Society.

APPLIED ART SECTION.

Tuesday, May 10, 1904; H. H. S. Cunynghame, C.B., Member of the Council, in the chair.

The Chairman, in introducing the reader of the paper, said the subject to be dealt with was extremely interesting from many points of view. In the first place, owing to Mr. Burton's very great knowledge of the whole question of glazes, he could not fail to give information of great interest, and secondly, the author's scientific understanding of the subject had lead to some new developments which would be described in detail. Two or three years ago the question of the danger of lead glazes to the potters came prominently before the officials at the Home Office. There was a desire to save the lives of the potters, and not allow them to be poisoned with lead; and on the other hand, there was the danger of seriously damaging a great English industry. The problem was ultimately solved by several sets of rules, and he earnestly hoped that the last of those rules had been promulgated, and that the question was now upon a satisfactory footing. All through the negotiations the master-potters as a body met the authorities in the fairest way. It was quite wrong to imagine that the potters wished to poison their men; he had rarely seen an instance in which employers had so willingly came forward to do what they reasonably could to prevent injury to their men; and among those potters there was none who helped more than Mr. Burton to show how a solution could be arrived at which, while it should stop lead poisoning, would, on the other hand, leave the industry untouched. They felt throughout the whole proceedings that in Mr. Burton the public had a most honest, fair-minded adviser, and one who, in technical skill, was probably amongst the most expert potters, not only in England, but perhaps in the world.

The paper read was—

CRYSTALLINE GLAZES AND THEIR APPLICATION TO THE DECORATION OF POTTERY.

By William Burton, F.C.S.

The production of crystalline glazes of certain types has for some ten years now been engaging the attention of those Continental potters whose work is conducted on scientific principles, and by this time every one interested in modern pottery must be

familiar with the fine blue and brown glazes showing starry and radiating crystalline groups that are being produced at Copenhagen, and Sèvres, Röstrand and Berlin. Some three or four years ago, in a paper I had the honour to read before this Section, I drew attention to these crystalline glazes, as well as to others of a very different type which had been produced at the Rookwood Pottery in America, and by my brother, Mr. Joseph Burton, at our works at Clifton Junction. Since then, however, the whole subject of crystalline glazes and their production with scientific precision, so that they might be used as a certain and regular means of pottery decoration rather than as the occasional triumphs of the kiln, has been engaging a great deal of our attention, and if in certain directions the results are not yet all that might be wished, such a measure of success has attended our experiments as to warrant me in laying the results before you.

It is essential, first of all, that one should try to form some conception of what a pottery glaze is, and as to how it behaves when it is melted on a piece of pottery at the requisite temperature of the kiln, and under the firing conditions which control production on a large scale.

The popular idea of a glaze, as of a sheet of window glass, is that of a uniform transparent substance, which may be either coloured or colourless, and which is melted on the surface of the pottery so as to form an impervious, protective layer. Such a conception is, however, very wide of the truth. In the first place, a glaze like any other form of glass is not, either physically or chemically, a uniform substance. Though it may be possible to produce glaze to which one can give an approximate chemical formula, no chemist would suggest for a moment that such a formula represented anything more than the ultimate percentage composition of a mixed mass which might be compounded in many different ways. A glaze, like any other form of glass, is really a complex of various silicates, very loosely combined, even if they are combined with each other.

Undoubtedly, the correct view of the nature of glaze is that which regards it as an alloy in which the various silicates play the same part as the separate metals in a metallic alloy. With the same ultimate chemical composition, the particular silicates that will be formed in any given glaze will differ within very wide limits according to the temperature and duration of firing, and the relation betwe the glaze and the kind of pottery on which it applied. With a glaze and body of the san ultimate chemical composition produced und firing conditions which are fairly constant, is possible to obtain constant results, but any of these conditions vary from time to tim as they will in manufacturing processes co ducted on a large scale, then, of course, t results will vary too. It has been found by t accumulated experience of generation aft generation of potters, that certain types glaze have fairly wide limits of stability withi which they will produce satisfactory results while there are other types of glaze whic have such narrow limits of stability that th are of very little use for commercial wor their limits being narrower than those com monly met with in every-day practice.

Thus it is that after the experience centuries, we find certain types of glaz associated with certain types of potter throughout the civilised world. The univers use of a felspathic glaze on hard porcelain; tin enamel on faïence or "Delft;" of salt glaze on stoneware; and of lead glazes o earthenwares made after the English fashion are the common illustrations that will occur t everyone. It would, of course, be possible t use glazes of other types on each of thes varieties of pottery, but in every case th glaze which has become as it were, commo or traditional, is the one which experience ha proved to fulfil most completely all th conditions of that particular branch of manu facture. Another feature of pottery glaze which marks them out from glass and fro the enamels used on metals, is the fact tha the glaze is melted or produced on a bed o silica and mixed silicates analogous in compo sition to the glaze itself. When a transparen enamel is melted at a low temperature on sheet of metal, there is practically no chemica action between the molten enamel and the be on which it lies. On the other hand, when a pottery glaze of any type is melted on a piec of ware, there is a decided and in some case a strongly-marked chemical action betwee glaze and ware. One of the well-marke properties of complex silicates is the readines with which, at high temperatures, they wil dissolve into each other, and in nothing is thi more clearly shown than in the way which a melted glaze attacks the surface of the potter on which it is fired.

One of the simplest experiments in a chemical laboratory is to dissolve clay by

heating it up with a sufficient quantity of lead oxide. At a fairly low temperature the lead oxide melts and dissolves the clay just as perfectly, though not so rapidly, as hot water would dissolve lump sugar. Many other metallic oxides would behave precisely like lead oxide, in fact it is only a question of getting any particular oxide in a molten or vaporous condition to enable this action to take place. In pottery manufacture this solvent action of melted oxides upon clay has been used as a means of producing glazed pottery for many centuries. The common mediæval green and yellow glazed pottery made over the whole of Western Europe was produced in this manner. When the vessel had been shaped in any common clay it was dusted over with powdered lead ore (generally galena, the native sulphide of lead), and the clay vessel thus coated was placed in the potter's kiln and fired. The first result of the firing would be to drive the sulphur out of the lead ore, which the increasing heat then slowly roasted into oxide of lead. This oxide of lead in its turn melted and attacked the clay body, now become red hot. In this way, and at one operation, the ware was hardened from clay into pottery, and its surface was coated with a brilliant glassy compound of lead oxide, alumina and silica. The well-known salt-glaze of stonewares is produced by an entirely analogous method though with very different materials, and at a much higher temperature. In this case the clay vessels are put into the kiln without any glazing substance upon them. They are then fired to a white heat, at which point the silicates present in the clay itself commence to fuse. When this temperature has been reached, wet common salt is thrown into the kiln and is rapidly decomposed with the formation of vapours of oxide of sodium and hydrochloric acid. The oxide of sodium vapour coming in contact with the white hot stoneware melts some of the clay substance, just as the lead oxide would do, and forms a glass of soda, alumina, and silica on the surface of the ware, which is the well-known salt-glaze.

It might be imagined that while vaporised or melted, metallic oxides are thus capable of attacking and dissolving the surface of a piece of pottery and forming an actual glass with it, natural or artificial silicates, such as the felspar used in glazing hard-paste porcelain, or the fritted glazes used on English earthenware and porcelain would not necessarily have the same effect. Experience proves, however, that they have this effect. Even molten felspar, which is already a complex silicate of potash, soda and alumina, or of soda, lime and alumina, when it is melted at the high temperature of the porcelain furnace, actually dissolves some of the clay substance. A microscopic examination of a thin slice of hard-paste porcelain, prepared exactly as one would prepare a rock section, shows three clearly marked layers — (*a*) an outer skin of clear glaze; (*b*) inside that an intermediate "felted" layer; (*c*) the body of the ware itself. The intermediate felted layer is clearly a mixture of glaze and body where the molten glaze has attacked the body, and dissolved some of its constituents. The same effect is shown, though generally to a less marked degree, with the ordinary fritted glazes used on English earthenware. When these glazes are fired at a high temperature on earthenware, and the fire is unduly prolonged so as to give a longer time for the action to take place, it is found that their solvent action becomes quite pronounced. I have here a tile of ordinary English earthenware which has been submitted to a prolonged firing, and the glaze has so attacked the body of the tile that it has eaten into it in places, leaving certain portions of the edge exposed almost like bits of hard rock on the edge of a precipice from which all the covering soil has been washed away.

Incidentally, it may be remarked that even those scientific men who have studied the chemistry of pottery most carefully, appear to have overlooked the influence of this solvent action of the glaze upon the body, and the consequent formation of an intermediate layer, with the cracking of glazes which is known technically as "Crazing." A moment's reflection will convince anyone who is familiar with the various kinds of pottery that it is precisely the hard-fired varieties, in which the formation of this intermediate layer is strongly marked, that are least liable to this defect. In the case where a glaze has been melted on pottery at so low a temperature that it is practically unable to dissolve any of the body substance, crazing takes place most readily.

It follows from what has been said that one should always look upon a piece of glazed pottery as exhibiting a gradual progression from the outer skin of what is technically called the glaze to the true body or clay substance, with an intermediate layer within which body and glaze are in various states of

transfusion. As to the exact relation which the intermediate layer bears to the true glaze itself, the three controlling factors are—(*a*) the chemical nature of the glaze; (*b*) the chemical composition of the body, and (*c*) the degree and duration of the firing to which they have been subjected.

Having clearly established why a pottery glaze behaves, when it is melted, like any other fluid, there is no difficulty in imagining a molten glaze as capable of dissolving certain other substances which may be presented to it. Thus if the clay substance contains a considerable quantity of free oxide of iron, as all the common red clays do, a molten glaze of suitable composition would dissolve that oxide of iron; and if the iron oxide were present in sufficient quantity, the glaze might even become saturated with it. Everyone who has studied the formation of crystalline bodies knows that one of the readiest methods of obtaining such substances in a perfect condition is by dissolving them in fluids and allowing them to crystallise out as the menstruum becomes more concentrated. The same results can be obtained to a less perfect degree when the solvent is saturated at a high temperature and allowed to cool slowly. Under such circumstances, when the solution is cooled, it is no longer able to retain all the dissolved substance, and if this substance be a crystallisable one, it will separate out in the crystalline form. These conditions can be obtained perfectly in the process of firing pottery glazes, and it so happens that the earliest piece of crystalline glaze which has ever been described was formed in this simple way. There is, in the British Museum collection, a Staffordshire tyg of the 17th century, the body of which is of common red clay, glazed by firing on it powdered galena in the manner already described. When the lead oxide formed from the galena was melted in contact with the clay at a bright red heat, it dissolved some of the silica and alumina of the clay so as to form a lead glaze. This lead glaze must also have dissolved in its turn some of the oxide of iron contained in the clay, and on cooling, this oxide of iron, being in excess of what the glaze could retain in solution, has crystallised out, and the glaze is filled in its under layer with brilliant sparkling crystals, giving it an appearance very much like that of the beautiful mineral known as "Aventurine." In recent years this particular form of crystalline glaze has been largely developed at the Rookwood pottery in America, and some specimens which they have produced are quite remarkable, and at the same time singularly beautiful, from the silky golden sheen of the crystals seen under a layer of clear yellow glaze. When glazes of this type are produced on suitable shapes, the natural flow of the glaze down the side of the vase tends to arrange the crystals in lines, with their long axes in the direction of the line of flow, with the result that in specimens that have been slowly cooled so that the changes should have time to take place perfectly, a beautiful striated effect is produced, very similar to that given by the asbestiform threads in the mineral "Crocidolite" or tiger-eye stone of South Africa. By the kindness of the authorities of the Victoria and Albert Museum I am able to exhibit here to-night, some of the most perfect specimens that I have ever seen from the Rookwood pottery, while I have also a group of vases showing crystalline glazes of the same type from my own factory. I have spoken as if the crystals obtained in this way might be simply pure oxide of iron which had crystallised out from the glaze as it cooled, but in all probability the crystals are not simply oxide of iron, but small crystalline plates apparently belonging, by their appearance and optical properties, to that large group of minerals known as "Micas." This being the case, we must look upon the crystals, whatever may be their ultimate chemical composition, as one of the complex silicates formed in a glaze which separates out from the other silicates with which it is associated, in such a way as to be visible to the naked eye. We must therefore regard these crystalline glazes not as being entirely different from the clear and apparently homogeneous glazes which the potter generally obtains, but as glazes constituted like all other glazes, save that some of the mixed silicates have separated out from the rest in a crystalline form. Another point which may just be mentioned in passing, is that although these crystalline glazes were obtained in the first place accidentally by means of the oxide of iron which the glaze had dissolved from the body, they can just as well be obtained by adding the oxide of iron to the glaze mixture itself before firing. Other oxides, particularly those of chromium and uranium, readily yield glazes of a similar character. It is now nearly ten years since my brother first turned this knowledge to account in the production of our Sunstone glazes, many of which are exhibited here. These can be obtained in a variety of colours;

thus we have many shades of green, of yellow and of brown, while at a hard fire, approaching to that of true porcelain, they develop a strong steely-blue colour. A microscopical examination of our sun-stone glazes proves that they are very similar in their optical properties to those of the Aventurine or tiger-eye glazes already described. The crystals are small hexagonal plates having the general character of "Micas."

The decorative effect of these sunstone glazes, though rich and subdued, is yet very striking, for in addition to the clouds of brilliant golden crystals which are disseminated through the green, olive, brown or yellow glazes, we have found that the mixtures which give the best crystalline effects have peculiar colour qualities such as have never been obtained in pottery glazes of the ordinary type, so that in colour alone they are a decided addition to the potter's palette.

We must now enter on the consideration of the better known crystalline glazes that have been produced of late years on the hard-fired porcelains and stonewares of the Continent. In this case the crystals appear as radiating needle-like or starry groups, sometimes white —when they recall the patterns traced on the window pane by frost—sometimes brilliantly coloured blue or green, or at other times having a fine bronzy sheen recalling that of burnished metal. In this case there is no question of any extraneous oxide dissolved by the glaze setting up a crystallisation. The glazes which give these wonderful crystalline forms are the ordinary felspathic glazes used on true porcelain, to which have been added artificial frits carefully compounded so as to be in effect tri-silicates of zinc, or of zinc and potash. At the high temperature of firing, which in this case approaches 1,350°C., all the constituents of the glaze melt to an apparently uniform glass, but, on cooling, some of the silicates, probably the silicate of zinc, or a silicate of zinc and alumina separate out from the remainder, and assume these beautiful crystalline forms. We have found on our own works that the same effects can be produced whether the silicate of zinc be added to the glazing mixture as an artificial substance obtained by melting together at a very high temperature the requisite proportions of oxide of zinc and silica, or as the natural mineral silicate of zinc, known as "Willemite." There is a very singular fact in connection with these crystals which may throw some light on their constitution, and that is, when the general colouring oxides used by potters are added to these glazes the crystals behave differently with oxide of copper CuO. than they do with oxide of cobalt Co_2O_3. or oxide of iron Fe_2O_3. If the glaze contains oxide of copper, the crystals separate out as white colourless needles, but in the other cases the crystals absorb a large proportion of the oxide of cobalt or oxide of iron contained in the glaze, becoming, in the first case, of a brilliant cyanine blue, and in the latter case of a fine yellow bronze colour almost like yellow metal.

[A number of specimens of crystalline glazes of various colours from Copenhagen, Röstrand, and Sèvres were exhibited.]

Considering that these crystalline glazes were first developed in Europe on true porcelain, it is rather remarkable that the Chinese and Japanese do not appear to have produced such effects even accidentally. Probably this is due to the fact that, so far as we are aware, they have never used oxide of zinc as an ingredient of their glazes. Quite recently Mr. Bernard Moore drew my attention to a few specimens of modern Japanese porcelain in which small cryptocrystalline patches are strongly marked. I have here on the table one of these pieces which I found some time ago in London, and as from the peculiar tone of the glaze I am convinced that the glaze contains zinc, I think that there can be no doubt that the wide-awake Japanese are already turning their attention to the production of crystalline glazes like those on the modern porcelains of Europe. Their results at present are very rudimentary, but in a few years' time European potters may have to look to their laurels in this scientific development of pottery decoration also.

Hitherto it has always been considered by the continental potters who have been working with this type of crystalline glaze, that it was impossible to obtain good results at a lower temperature than 1,250° to 1,350° C., and that consequently the crystalline effects could not be produced on earthenwares, the glaze of which is fired at so much lower a temperature. After a series of researches extending over several years, it has, however, been proved at our works that crystalline glazes identical in type, in colour, and in decorative effect, can be produced on English earthenware at temperatures even as low as 1,000° C. I am able to show you to-night a number of vases decorated in this way with crystalline glazes, and all on the body of our English earthenware. Moreover, by

treating tiles of this kind exactly as one would treat a piece of mineral in order to obtain a thin section, I hope to show you on the screen with the lantern, slices of crystalline glaze which will demonstrate how perfectly developed and symmetrically arranged the groups of crystals are.

Although we have succeeded for the first time in producing crystalline glazes similar to those on the hard-paste porcelains of the Continent, at temperatures much lower than they have ever been made before, we were faced with the same difficulty that the Continental potters experienced, from the capricious way in which the crystals are developed, even when every imaginable care has been taken to ensure regular and perfect conditions. In all the Continental work these glazes have been used all over the piece, leaving the crystals to develop very much as they may. Were it possible to produce these crystal growths exactly where and as one wishes on the surface of a vase, a dish, or a plate, it would be possible to turn them to the highest decorative account by combining them with painting, or relieving them with other colours. As it is, the glazes are too capricious to admit of such perfect control; we are too much at the mercy of the kiln, or as one ought to say, we do not know sufficiently how to govern the conditions which determine the formation of the crystals, to use them just as we would. You will have observed in all the examples of vases, photographs of which have been thrown upon the screen, and in all the specimens actually displayed here upon the table to-night, how capricious the results are, indeed I believe in many of the Continental factories it is possible to produce only a small percentage of really fine examples, so that there still remained a wide field for the exercise of the patient skill of the English potter.

I have now to bring before your notice an entirely novel and most striking variety of crystalline glaze, that was discovered in our researches in this direction about twelve months ago, and the whole science of which is so well known to us, that it is as perfectly under control as the production of the commonest coloured glaze used on garden pots or tiles. The glaze in question is in itself of a bright yellow colour, but it is shot through and through with lines, groups, or patches of brilliant golden, prismatic crystals. These crystals have very much the same optical character as those found in the sunstone glaze already referred to, but they are considerably larger, and are so brilliant th they make the vase or piece of pottery which they are applied shine like burnish copper, or like a piece of fine Japanese go lacquer. Scientifically and technically, the mo singular feature of these latest crystalline gla is the effect on them of a gradually increasi temperature. The crystals are developed their full perfection and brilliance only wh the glaze is matured at a temperature of fro 1,000°C. to 1,030°C. When the firing temper ture is increased, the crystals are reabsorb by degrees into the glaze, and between 1,050° and 1,070°C., while the crystals are mu smaller, the glaze generally assumes a beautif purple tone. Above 1,070°C. the crystals a entirely reabsorbed, and the glaze once mo becomes of a brownish-yellow colour which more or less opaque.

[A number of vases which showed all the transitional stages produced by varying d grees of fire were exhibited.]

It would be impossible to find a clearer more perfect exemplification of the statemen made in the early part of this paper as to th real nature of pottery glazes. Here, at one stag of the firing, some of the silicates are in suc a loose state of combination that they will sepa rate out from the general body of the glaze thin, prismatic, crystalline plates. If the firin be pushed further, these crystalline separation are dissolved at a higher temperature by th other silicates of the glazes, until, at a high temperature still, they form an apparentl homogeneous compound, in which no trace of crystallisation are apparent. It is possibl however, to regulate the firing of a moder pottery kiln so perfectly that we can produc exactly the kind or degree of crystallisatio we require, so that these crystalline glaze along with the sunstone glazes, can be use in conjunction with other colours, *i.e.*, the take their place in a decorative colour schem with other pottery colours of an entirel different character. The first and most obviou method of turning them to account is that using them on pieces decorated with variou coloured clays. Here are a number of vase which have been shaped in a dark buff clay patterns have then been painted on them i white slip, and the crystalline glaze being lai over the whole piece we get a very simple form of decoration, which while it enables th crystals to display their beauty, gives them a added interest and variety which is all to th good artistically.

Reverting now for the moment to the ide

that these crystalline glazes only differ from the more ordinary glazes in common use, because some of the complex silicates existing in the glaze naturally assume these crystalline forms and so render themselves visible, it follows naturally that we may have other glazes in which some of the complex silicates show themselves, not as crystalline growths, but by exhibiting different degrees of transparency, or by possessing a different refractive index from the mass of the glaze itself.

It will be within the recollection of everyone present that within the last few years a great deal of attention has been paid in this country to the possibility of using leadless glazes on all our English earthenwares. Were such a consummation possible, it would afford the most perfect solution of the problem that besets pottery manufacturers whose glazes are fired at comparatively low temperatures, in protecting the health of their workpeople. Unfortunately, however, while it is possible to make leadless glazes under certain conditions and on certain classes of ware, one of the most irritating faults of leadless glazes fired at low temperatures is their tendency to become opalescent or milky. While this defect may not prevent the use of such glazes on white wares, it is often an absolute barrier to their use where the glaze has to be used on certain colours or certain types of body. Seeing this constant tendency of leadless glazes to produce a cloudy or striated opalescence, it has occurred to us that this might be turned to exceedingly good account artistically.

While the problem of the potter ordinarily is to produce glazes which are uniform in texture and in tint, we have striven to produce a series of glazes which should develop layers, streaks, or patches of opalescent, feathered, or clouded colour. In pursuing this aim we were faced with another of the difficulties generally associated with leadless glaze unless it is fired at a very high temperature, viz., a constant tendency to bubbling and blistering in the fire. We have found it possible, however, by the introduction of varying quantities of lead frit, to overcome this difficulty also, without impairing the opalescent effect at which we were aiming, and we are now able to produce opalescent glazes in the widest possible range of colours, from pure white or palest ivory to deep brown, orange or purple, which fire as perfectly as any ordinary glaze while at the same time they produce the most varied effects of colour in subtle and beautiful gradations.

I have here a piece of frit, used as the basis of one of these opalescent glazes. As you will see, it is a brilliant clear glass, apparently quite homogeneous. The same frit ground to a fine powder and fired on the surface of a piece of pottery is no longer homogeneous, even to the eye, but shows striæ, which may be infinitely finer than they could be drawn by a painter, or may take the form of more or less opaque featherings or cloudings. The forms assumed by these striæ are so subtle, and so varied, that the resultant glazes have been compared by different observers to all kinds of beautiful natural products; to finely-grained and highly-polished woods, to polished serpentine, agate and jasper; to the feathery moss in a running stream, and to the lightest *cirri* in the summer sky; yet they are nothing but the revelation to our unaided vision of the highly complex nature of a simple pottery glaze. Scientifically these new glazes are of the deepest interest. They have been carefully compounded so as to be of definite composition, and so that all the molecules of acid and of base should be satisfied. When they are ground up and melted on the clay they dissolve some of the silica at a high temperature—the chemical equilibrium is disturbed, and we have a separation of the molecular constituents of the glaze rendered visible by the differences of colour or of refractive index that they display. Thus by the application of science to one of the oldest industries, new and hitherto unapplied effects have been obtained which are more subtle and more beautiful in their play of colour than anything that could be painted by the hand of man.

Lastly, we have found it possible to combine these opalescent glazes with the crystalline glazes of the continental type, so that the groups of starry crystals are developed in conjunction with finely streaked opalescent colour as a background. At the same time, too, the crystals are formed with much greater certainty, and are to that extent under control, so that if we are not able every time to develop crystalline groups just as, and where we wish, we can be certain that the result will be a beautiful network of colour, of subtle gradation, enhanced by glowing crystalline forms, caught, as it were, within the meshes of the net. Here are a number of vases exhibiting these latest results, and I hope you will agree with me that they are as beautiful artistically as they are wonderful from the technical resources displayed in their production.

DISCUSSION.

Mr. LANGTON DOUGLAS said it was with the greatest delight that he had heard there was a real and definite prospect, in spite of modern industrial conditions, that the beautiful art work which had been exhibited would be manfactured in England. As one who had listened with the greatest interest to the paper, he wished to express his sincere thanks to the author for his paper.

Mr. W. AULT said the author spoke of the certainty with which the different effects were produced in the coloured glazes. He would like to ask whether sulphur was never encountered, and whether that did not interfere sometimes with the results. Had Mr. Burton been able to avoid that difficulty which many potters experienced?

The CHAIRMAN said, that in considering the paper, one aspect of the question had particularly struck him, viz., the artistic spirit which had too often dominated, and was at present too much dominating, the manufacture of earthenware and china, and all industrial art in England. There was no question that, in the time of Queen Anne, people liked to have a porcelain service from China, and, therefore, everybody wanted one, and the consequence was, that the potters had to imitate, as well as they could, the Chinese porcelain. By degrees, when people began to know that it did not come from China, they Anglicised the china a little, and one saw, in the early periods, the most ridiculous imitations. At first there was a fraudulent attempt to say it came from China; then the artist did not attempt the fraud, but simply made it. If they took the ordinary jugs and basins of to-day, the work would remind them of a thing which had been made by somebody who had seen the work of somebody else, who had derived his knowledge from somebody else who had been imitating China. It was China so Anglicised, that it had become almost English. The extraordinary thing was, that whereas they had an art that was finer than the Chinese art, viz., the art of the Italians, it did not seem to have struck anybody to work on that line. It was perfectly astonishing that they should not have dessert dishes of faïence ware with delightful designs copied from those of Raphael, or Burne-Jones. Some most beautiful things might be done in black, yellow, and blue. The manufacturer must not be afraid of doing them roughly; their charm was the great breadth of colour, and the brilliant effect would be lost if they attempted to put the strength too much upon finish. If one went to one of the good working potters in the factories he would say, "Is not that a beautiful blue; there are sixty plates, and you cannot detect a difference of blue in one plate from the other; they are exactly the same diameter; you will not find $\frac{1}{64}$th inch difference in the measure of the plate from the top to the bottom and in the width across." That was the potter's opinion of art. If one said, "But of what use was such accuracy?" he would get the reply, "But surely you would not have things that do not match?" One great charm of works of art was that each was different, and one would very much like to see people content to have porcelain services in which every plate differed from the other. Therefore the first thing that struck one in connection with the glazes described was the way in which they lent themselves to something more like true art. If one took the old Italian faïences, whole groups of plates would be found that had evidently been made in a series; they had been painted, but the colours and the pattern were not exactly alike; they were of the same model, but they varied one from the other. They could help the artistic movement by cultivating that true artistic sense which desired variety and individuality, even in a whole set of china, which would even be tolerated at a dinner party—the plates set on the table being different from each other; they might have one Wedgwood, the other a piece of faïence, the other a piece of Sèvres, and the other a piece of Dresden. The reason why one welcomed vases like those shown was not that one cared about scientific curiosities, in which there were marvellous crystals which no one had made before, but because they had begun to recognise some of the charm of the variety of nature. If you looked at a piece of flint or some rare stone in the British Museum, you admired it immensely because of the variety of veins in it. Why should not one apply the same rule to a piece of modern pottery? If there was to be a revival of art, it seemed to him that glazes of the kind described would form a large feature of the pottery art of the future. For that reason he welcomed the author's efforts in the direction of artistic decoration and variety.

Mr. F. RAWDON SMITH thought they had had an object-lesson, and that the general idea to be deduced therefrom was that the art of the English potter must, for the future, come from the scientific side. Potters had perhaps been far too long guided by rule of thumb, yet at any rate English potters had, somehow or other, managed to produce some of the most marvellous wares that had ever been seen, so far as Europe was concerned, for we must put aside the produce of China and Japan. They now had a method indicated to them which, little as he knew of it, had an absolutely indefinite ending; that in following out this thing scientifically, one discovery would lead to another. He thought the author almost let the cat out of the bag when he said that the potter so often put his ware into the kiln hoping for one thing, and found something totally different when he drew it out of the kiln, and yet such methods of discovery had been, in former times, the secret of the potter's art.

Prof. R. A GREGORY said the chief point in the paper which appealed to him more than any other

was that Mr. Burton, who, he was proud to say, was a fellow student of his, was a man of science who had applied his scientific knowledge to the production of wonderful artistic effects. While England had men like the author taking a leading part in the development of the industries of the country, it need not fear any foreign competition; if all industrial matters were in the hands of men with the scientific knowledge and progressive spirit that Mr. Burton possessed, the position of British industry would be made secure against the competition of other nations. As one who followed the work done in the scientific world, it was most gratifying to see the author's work developed entirely on a scientific basis. To know that in a great pottery establishment one had the means of regulating temperatures to within a couple of degrees Centigrade, was quite a revelation to a student fairly familiar with scientific literature; and the production of the crystalline glazes in the way described was, he thought, a most gratifying instance of the combination of science and art. When the two were combined in that way, it seemed to him that British industry was in a fair way to show the world the road of progress in the future, as it had done in the past.

Mr. Lewis Day said that science had been so rampant all the evening that he should have liked to have said something on the other side; but, as it happened, he was himself, for once, all on the side of science. The artistic fad of the day seemed to be to go in for flukes. Beautiful things resulted in that way. Some of the things that a potter had to deal with naturally gave him beautiful colours. If he put certain things together, and prayed to heaven for success, there was no knowing what might come of it. Artists who took up pottery work had been wont to rely a great deal too much upon that same fluke. When it came out all right, they were greatly exalted; when it came out all wrong they blamed the fire and all sorts of things, when really what was to blame was their own ignorance. It was not sufficiently realised that the artist in pottery must have absolute control over the things he was working with. Accident led to beautiful effects; but accident was no credit whatever to the man to whom the accident happened, and he need not be so proud of happening upon something. The uniformity to which the Chairman alluded was a great deal too much the aim of the British potter and of the manufacturer and of the Britisher generally, but it was quite possible to go a little too far in the other direction. There must be some sort of uniformity in many of the things made. Mr. Burton, who had perfected the vases shown, was also a tile maker, and he could not help thinking that apart from the scientific instinct, he had been led to his precision of workmanship to some extent by his experience as a tile manufacturer. For instance, he knew that he must make tiles not only that were beautiful, but the effect of which he was able to reproduce. When an architect had to tile a wall, or whatever it might be, he wanted to know that he would get something approximately like the sample he had seen. That Mr. Burton had endeavoured to keep, and had kept in view, and it appeared to him to be the only basis of proper manufacture. So far he was entirely on the side of the man of science and dead against the artist, who thought too little of science. Mr. Burton's achievements in pottery were well known to him, and he had often admired them: he had seen his pots in all their stages of development, and no one enjoyed them better than he did; but he enjoyed them all the more since his explanation that evening of the way in which they were produced. The description of the way in which the glaze attacked the body of the vase, interested him very much indeed; he had seen that effect over and over again, but never knew how it happened until Mr. Burton explained it. Now Mr. Burton had told them how that happened, it seemed to him it ought to have been self-evident on the face of it, and he felt what a fool he was not to have found it out for himself. The control which Mr. Burton exercised over the glazes was admirable; he chose certain shapes to go with certain glazes, and certain glazes to go with certain shapes, and so that he got, approximately, what he liked. He made hollows for the crystalline glazes to accumulate in, and channels for them to flow in, which seemed to him to be the proper artistic control that a man should have over his means. Mr. Rawdon Smith had called the paper an object-lesson—it was an object-lesson in the necessity of knowledge, of science, before a man began to play about with pottery. It was, in fact, the only qualification which enabled a man to do anything at all in pottery.

A vote of thanks to Mr. Burton having been carried unanimously,

Mr. Burton, in reply, said he was extremely obliged to the audience for the patience and kindness with which they had listened to him. It had been a very great privilege to explain, as well as he could, the results of all his years of labour. He was primarily a tile maker, and he had only turned to pottery making because he had to; so many effects were produced that were beautiful in themselves, but absolutely useless on the surface of a tile; it was necessary to have a rounded surface in order to see how beautiful they were. So that, quite against his will, he had been driven to make vases as well as tiles; it was really only by way of amusement he had turned potter. On the table he was able to show, and presently he would show on a larger scale, what he and his brother had done for ten years. They had not offered a single piece for sale; the present was the first time the vases had been shown publicly; and he was very glad indeed that the Society had done him the honour of asking him to read the paper.

Obituary.

Mr. Jamsetjee Nusserwanjee Tata, the well-known millionaire and philanthropist of Bombay, who died at Bad Nauheim on the 19th inst., became a member of the Society in 1900. He devoted a considerable portion of the large fortune which he had acquired to public objects intended for the benefit of the people of India, and for the development of Indian industrial resources. He spent large sums of money in endeavouring to improve the staple of Indian cotton, and also on the improvement of sericulture in Mysore. Mr. Tata established a number of scholarships intended to help Indian youths to prepare for the Indian Civil Service, and also to study various branches of technology in this country and on the continent. He offered to the Government of India, on certain conditions, the enormous sum of £150,000 for the endowment of research. The conditions of the offer were such as, up to the present date, to prevent the Government from accepting it. It is, however, understood that the offer is still open, the amount of the endowment being left in the hands of trustees who have power to negotiate with the Government of India for its application. Mr. Tata enjoyed a very high reputation among both his fellow countrymen and Anglo-Indians for his liberality, and the assistance he was always ready to give to useful charities will be greatly missed. He took a warm interest in the work of the Society, and constantly recommended its publications to the notice of his fellow countrymen.

General Notes.

Silk Culture in Russia.—According to a recent report by the Russian Ministry of Finance, the yield of silk in Russia is not very great, hardly exceeding, during the last few years, sixteen tons of dried cocoons, representing a value of from £3,000 to £4,000. A Moscow mill buys up the greater part of the supply. A small part is worked up locally, but the small local factories are gradually losing ground in their competition against the big mills. The production of the Caucasus amounted, during the last few years, to about 2,539 tons of dried cocoons. Kutais and Etizaretpol are the governments in which sericulture has progressed best. In the towns of Micha and Schuscha, there are about fifty factories which consume the whole cocoon supply of the eastern part of Transcaucasia. There is, therefore, no export of cocoons from this district. Although no reliable statistics are available regarding the cocoons of Central Asia, it is estimated at about 2,179 tons, of a value of about £515,000.

MEETINGS OF THE SOCIETY.

Indian Section.

Afternoon, at 4.30 o'clock :—

Tuesday, May 31.—" The Economic and Industrial Progress and Condition of India." By J. E. O'Conor, C.I.E., late Director-General of Statistics, India. Sir James L. Mackay, G.C.M.G., K.C.I.E., will preside.

MEETINGS FOR THE ENSUING WEEK.

Monday, May 30...Surveyors, 12, Great George-street, S.W., 3 p.m. Annual Meeting.

Geographical, University of London, Burlington-gardens, W., 8½ p.m.

Tuesday, May 31...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Indian Section.) Mr. J. E. O'Conor, " The Economic and Industrial Progress and Condition of India."

Royal Institution, Albemarle-street, W., 5 p.m. Mr. H. F. Newall, " The Solar Corona." (Lecture I.)

Wednesday, June 1...Ambidextral Culture Society, 11, Chandos-street, W., 5 p.m. Miss Werner, " Ambidexterity among the Zulus and other African Tribes."

Royal Archæological Institution, 20, Hanover-square, W., 4 p.m. 1. Mr. C. R. Peers, " The White Monastery, near Sohag, Upper Egypt." 2. Mr. Philip M. Johnston, " The Wall Paintings in Shorthampton Church, Oxfordshire."

Obstetrical, 20, Hanover-square, W.C., 8 p.m.

Thursday, June 2...Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Linnean, Burlington-house, W., 8 p.m. 1. Sir Jos. D. Hooker, " The Species of *Impatiens* in the Wallichian Herbarium." 2. Dr. G. H. Fowler, " Biscayan Plankton. Part III. : Chaetognathia." 3. Prof. R. J. Anderson, " The Flow of Fluids in Plant-stems."

Chemical, Burlington-house, W., 8 p.m. 1. Mr. M. O. Forster, " Iso-Nitrosocamphor." 2. Mr. G. D. Lander, " Imino-ethers and allied compounds corresponding with the substituted oxamic esters." 3. Mr. H. R. Le Sueur, " The action of heat on a-hydroxycarboxylic acids " (Part I.); " a-Hydroxystearic acid." 4. Messrs. E. H. Archibald and D. McIntosh, " The basic properties of oxygen ; " " Additive derivatives of the halogen acids and organic compounds and the higher valencies of oxygen ; " " Asymmetric oxygen."

Royal Institution, Albemarle-street, W., 5 p.m. Mr. H. G. Wells, " Literature and the State." (Lecture II.)

Electrical Engineers, 92, Victoria-street, S.W , 5 p.m. Annual Meeting.

Friday, June 3...Royal Institution, Albemarle-street, W , 9 p.m. Prof. S. Arrhenius, " The Development of the Theory of Electrolytic Dissociation."

Geologists' Association, University College, W.C., 8 p.m.

Philological, University College, W.C., 8 p.m.

Quekett Microscopical Club, 20, Hanover-square, W.C., 8 p.m.

Saturday, June 4...Royal Institution, Albemarle-street, W., 3 p.m. Sir William Martin Conway, " Spitzbergen in the 17th century." (Lecture II.)

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FRIDAY, JUNE 3, 1904.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

INDIAN SECTION.

Tuesday afternoon, May 31, 1904; Sir James L. Mackay, G.C.M.G., K.C.I.E., in the chair. The paper read was "The Economic and Industrial Progress and Condition of India." By J. E. O'Conor, C.I.E., late Director-General of Statistics, India.

The paper and report of the discussion will be published in a future number of the *Journal*.

CONVERSAZIONE.

The Society's Conversazione will take place at the Royal Botanic Gardens, Regent's-park, on Monday evening, June 27th, from 9 to 12 p.m.

The programme of arrangements will be announced later.

Each member is entitled to a card for himself (which will not be transferable), and a card for a lady. These cards will be forwarded in due course. No application for them is required. In addition to this, a limited number of tickets will be sold to members of the Society, or to persons introduced by a member, at the price of 5s. each, if purchased before the date of the Conversazione. On that day the price will be raised to 7s. 6d.

Members can purchase these additional tickets by personal application, or by letter addressed to the Secretary. In all cases of application by letter a remittance must be enclosed. Each ticket will admit one person, either lady or gentleman.

Tickets will also be supplied to non-members on presentation of a letter of introduction from a member.

Light refreshments (tea, coffee, ices, claret cup, &c.) will be supplied.

Proceedings of the Society.

INDIAN SECTION.

Thursday afternoon, May 12, 1904; The Right Hon. Lord George Hamilton, G.C.S.I., M.P., in the chair.

The paper read was—

BRITISH-GROWN TEA.

By A. G. Stanton

(Of Gow, Wilson and Stanton).

Tea has lately attracted rather more notice than usual, owing to the recent increase in the duty, but the subject is always one of some interest to English people. It is found in the palace and the cottage, and there is perhaps hardly a household in the British Isles where it is not in use.

It is not many years ago that wine was generally drunk at ladies' afternoon parties, and this has now been entirely displaced by the use of tea, and probably with considerable benefit to the community at large, while even the poor woman who cannot afford to buy meat derives much comfort from tea, which forms no small part of her daily nourishment.

Wherever the British flag flies, the consumption of tea assuredly follows. The lumberman in Canada whose life is spent in felling his trees keeps his pot of tea going throughout the day, while the bushman in the wilds of Australia finds it a refreshing beverage, so easily portable as to be conveniently carried with him on his long journeys.

It is no wonder, then, that the idea should have been conceived by Englishmen of growing tea in our own dependencies, the first of these being the Indian Empire, where tea was cultivated as long ago as 1834. Indeed here, curiously enough, it was found growing wild about 1819-1821, and it has since become one of the staple industries in the country and grown to very important proportions.

In Ceylon it was not cultivated until a much later period when the agricultural prosperity of the island was almost ruined by the failure of the coffee industry, and here tea has now become the chief product of the island, and the means of bringing back prosperity to many planters who had been almost ruined.

Natal.

Our only other colony where tea has been commercially grown to any extent is Natal, which has special facilities for its

growth owing to the fact that imported tea is subject to a duty of 4d. per lb. which has not to be borne by tea grown in the colony. As there has been for some time a Customs Union between the Cape Government and Natal, that market was also opened to the growers free of duty, whilst the recent annexation of the Transvaal and the Orange River Colony and their inclusion in the Customs Union has opened a still larger market. Consequently, very little Natal tea goes outside our African dominions, so that in Natal the comparatively small quantity of tea under cultivation can easily find a remunerative market. The acreage at the present time totals 3,542.

TABLE I.—Acreage of Land under Tea, and Quantity produced in Natal.

Years.	Acres.	Production.
		lbs.
1880	8	not shown
1883	149	,,
1885	340	,,
1886	410	,,
1887	576	,,
1888	801	133,200
1889	1,090	43,024
1890	—	—
1891	1,231	281,710
1892	1,368	341,380
1893	1,883	576,420
1894	2,211	1,362,830
1895	2,297	737,000
1896	2,302	793,100
1897	2,665	848,930
1898	2,667	1,037,589
1899	No returns.	
1900	4,162	1,679,600
1901	4,107	1,720,150
1902	3,542	1,796,230

Experimental Cultivation.

The cultivation of tea was experimentally tried in Jamaica, Fiji, Borneo, and Mauritius, and the Straits Settlements, but except in the latter it has not gone beyond this experimental stage, although there are some 75 acres under cultivation in Jamaica. In the Straits Settlements 35,000 lbs. were produced in 1902. (See Table II.)

Tea other than British Grown.

Although this paper is not intended to deal with other kinds of tea than those grown on British soil, some allusion is necessary to the fact that practically all the tea cultivated in the world was grown in China for many centuries, its inception being so remote as to be unrecorded in history, and it was not until about the beginning of the 13th century that Japan became a tea-producing country, and has ever since continued such; the chief part of the tea trade of the world being in the hands of these two nations until its cultivation in British dependencies. British-grown tea has now almost entirely superseded the China product in the United Kingdom, as well as in some of our colonies, while it is gradually displacing it in many other important markets.

TABLE II.—Tables showing the Area and Cultivation of Tea in Some of Our Colonies.

Fiji.

	Acreage.	Production.		Acreage.	Production.
1888	325	Not shown	1895	180	Not shown
1889	Nil	,,	1896	220	,,
1890	Nil	,,	1897	210	,,
1891	250	,,	1898	210	,,
1892	456	,,	1899	210	,,
1893	460	,,	1900	210	,,
1894	410	,,	1901	236	,,

Mauritius.

	Acreage.	Production.		Acreage.	Production.
1900	100	Not shown	1901	145	Not shown

Jamaica.

1903.—About 75 acres.

Java.

Tea is also grown in the Island of Java, where plantation was commenced about the year 1826. The total produce of the island in 1890 was about 7,000,000 lbs. Since 1899 it has been gradually increasing, until it now amounts to very nearly twenty millions.

Cultivation and Manufacture.

The tea plant is closely allied to the camellia, and is by some writers classified as such. Unlike the camellias we are accustomed to see in this country, which are grown for producing as many flowers as possible, the opposite is the case with tea, the object of the cultivator being to obtain a copious supply of leaf, the flower being of no use for making tea; and the bush

not being allowed to flower except when grown for the purposes of producing seed.

For its successful cultivation the tea plant requires a sunny climate with an abundant rainfall. It is not often grown where the rainfall is less than about 100 inches per annum, and in some parts it is considerably over 200 inches. It likes a rich loamy soil, but also grows where there is a free subsoil, as the plant has a long tap root, and if this can penetrate some depth, it tends to the successful growth of the plant.

Its whole cultivation is carried out with a view to producing as much leaf of good quality as can be obtained without weakening the plant. It is usual to pluck only the fine shoots, it may be the leaf-bud and two or perhaps three leaves; if more leaves are plucked the tea becomes coarser and of lower quality. This plucking takes place at short intervals of about eight or nine days or so, when native women and children are employed to pick off the leaf and bring it into the factory in baskets. All descriptions of tea are prepared from the same plant, whether black, green, oolong, or fancy tea.

In olden times the preparation of black tea was much more primitive than it is now, the present system being, as soon as the leaf is plucked, to lay it out thinly on trays or sheets in order that it may wither, in which process the rigidity of the leaf-cells disappears and the leaf becomes soft and easily rolled.

When this withering process is accomplished, which depends a good deal on the state of the weather, the leaf is taken into the factory and rolled by machinery, the object of this being to break up the already softened leaf-cells, so that the sap then escapes and exudes. When these cells are broken up, the leaf is taken out of the roller and allowed to stand until fermentation, or rather oxidisation, sets in; during this process the leaf changes colour, and when it assumes a bright coppery tint fermentation is stopped by placing the leaf in the drier and firing it at a fairly high temperature; this fixes the fermentation, and in the process the colour of the leaf has changed to nearly black. The tea is then sorted through different sized sieves in order to make it suitable for requirements of different markets. It is then packed into chests and sent to the market in which it is to be sold, it may be Calcutta, Colombo, or London, whence it gradually finds its way to the consumer.

Green tea is not withered, but is steamed and then rolled, and immediately fired, without being allowed to ferment.

Consumption.

As regards consumption of tea, the greatest tea-drinkers are the British race, and of these Australasia takes more per head of population than any other, the annual total being about 7 lbs. per head. Great Britain comes next with 6 lbs., and Canada follows with nearly 4 lbs. No other nation in the world approaches these figures, Holland taking 1½ lb., Russia about 1¼ lb., and the United States about 1 lb.

The total production of tea in the whole world in the year 1902 was about 615,000,000 lbs. or rather the total exported from tea-producing countries, for it is impossible to ascertain the actual consumption in the country of production, and of this total Great Britain consumed 255,000,000 lbs. and her colonies 60,000,000 lbs., so that of all the tea the world produces at the present time, it may be said that the British race takes about half. Hence it is natural that the subject should be of interest to our fellow-countrymen whether here or abroad, and that they should have started the idea of tea cultivation in our own dominions, and should thus supply the home market, as well as our kinsmen abroad, with the product of our own capital and labour.

Early History of Indian Tea.

The way in which the Indian tea industry was commenced has been so often described that it is not necessary to go into its ancient history and the difficulties with which it has had to contend. A paper on the subject of Indian tea was read before the Society of Arts by the late Mr. J. Berry White, on the 27th May, 1887, and on "Tea" by the author of the present paper on the 23rd January, 1895.

The struggles through which the Indian tea planters had to pass in the younger days of its production have been well nigh forgotten, but the crisis which took place about 1863 nearly resulted in wrecking what has since become a great source of blessing to our Indian Empire, and grown into an industry such as has been able to employ over half a million of native Indians, as well as to give occupation to an immense number of our fellow-countrymen. (See Table III.)

Competition with China Tea.

Indian tea production continued to increase year by year, and its tea met with more and more favour in the English market to which, practically, the whole of it came for many years. Here it was brought into direct competition with the tea from China, which then held absolute control of the home market.

By degrees the public realised that Indian tea possessed more strength and flavour than that which they were generally in the habit of obtaining from China, and, consequently, the consumption of the latter gradually decreased. In 1866 it was about 97,000,000 lbs., while the consumption of Indian tea was under 5,000,000 lbs. China tea consumption increased until 1879, when it reached its maximum of about 124,000,000 lbs., while that of India was then only 34,000,000. From this date onwards the use of China tea gradually decreased until 1901, when it fell to 10,000,000 lbs., since which date slightly more has been used. At the present time it stands at the insignificant figure of 15,000,000 lbs., while Indian tea has risen to 151,000,000 lbs.

Rise of Ceylon.

The downfall of the China trade in Great Britain and her colonies was greatly accelerated by the growth of tea in Ceylon which, when when once it had started, continued at a rapid rate. The consumption in the United Kingdom in 1883 was about one million pounds, while in 1888 it had risen to 18 millions, in 1893 to 64 millions, and in 1903 to 78 millions.

The rise of the Ceylon tea industry has been so often described that an account of it would be superfluous; it dates from the devastation of the coffee plantations by the fungus, *Hemileia vastatrix*, which nearly ruined the island. Many of the coffee planters, however, turned their attention to tea, which was first grown for

TABLE III.—Showing the approximate Acreage under Tea Cultivation in India from 1875 to 1902—with the Annual Yield in lbs.—also the average Price obtained in the London Market since 1881.

Year.	Areas in acres.					Total area.	Yield in lbs.	Average price.
	Bengal.	Assam.	Madras, Punjab, and Burma.	United Provinces.	Travancore and Cochin.			s. d.
1875	23,162	89,300	8,972	3,402	—	124,836	26,526,317	—
1876	28,514	102,700	11,127	3,344	—	145,685	29,557,482	—
1877	30,000	140,921	13,540	3,500	—	187,961	36,143,045	—
1878	35,708	147,840	14,364	3,520	—	201,432	38,665,112	—
1879	38,668	150,610	12,191	3,843	—	205,312	38,727,076	—
1880	38,805	153,675	11,902	4,110	—	208,492	41,925,025	—
1881	42,217	158,427	12,582	8,445	—	221,671	46,371,622	1 5
1882	48,128	178,851	13,319	7,939	—	248,237	59,020,481	1 3
1883	49,000	189,453	13,500	8,618	—	260,571	61,000,000	1 2½
1884	55,698	189,852	13,733	8,427	—	267,710	65,947,946	1 1¾
1885	63,489	197,510	13,249	8,493	1,184	283,925	71,525,977	1 2½
1886	69,745	203,993	15,104	8,373	1,004	298,219	82,425,812	1 0
1887	73,641	211,079	14,039	8,280	5,764	312,803	92,252,082	11½
1888	79,961	216,676	15,376	8,266	4,048	324,327	99,792,544	10¾
1889	79,006	227,249	14,372	8,314	4,760	333,701	107,042,875	10¼
1890	85,573	231,038	15,060	7,977	5,179	344,827	112,036,406	10½
1891	90,831	241,823	15,294	8,032	6,457	362,437	123,867,902	10¼
1892	92,864	247,192	16,163	11,275	7,375	374,869	121,994,274	10
1893	110,510	256,625	13,448	7,419	7,837	395,839	132,247,900	9¼
1894	98,345	268,796	15,903	8,404	9,079	400,527	134,713,044	9¼
1895	104,197	276,290	17,236	8,514	9,480	415,717	143,407,827	9
1896	105,707	291,909	16,301	7,919	11,444	433,280	156,426,054	8¾
1897	119,190	310,826	17,465	7,965	14,672	470,118	153,782,208	9
1898	130,241	325,823	17,991	7,924	19,701	501,680	157,475,400	8·30
1899	132,923	330,038	21,724	7,858	23,115	515,658	181,797,455	8·75
1900	134,572	337,327	17,331	8,055	25,202	522,487	197,460,664	7·74
1901	135,129	338,186	17,921	8,252	25,279	524,767	191,302,773	7·50
1902	135,158	339,640	17,458	8,116	24,880	525,252	188,589,261	7·35

port in 1872, and in a few years they found at it flourished so well that thousands of res were placed under cultivation. A paper the "Ceylon Tea Industry," was read fore the Society of Arts, on the 21st January, 90, by Mr. John Loudoun Shand.

ABLE IV.—Showing the Acreage under Tea Cultivation in Ceylon since 1867, and the Quantity Exported since 1873, with the Average Price obtained in the London Market since 1880.

	Cultivated acreage.	Exports in pounds.	Approximate average price.
			s. d.
1867	10	—	—
1868	200	—	—
1869	250	—	—
1870	—	—	—
1871	—	—	—
1872	260	—	—
1873	280	23	—
1874	350	492	—
1875	1,080	1,438	—
1876	1,750	757	—
1877	2,720	2,105	—
1878	4,700	19,607	—
1879	6,500	95,969	—
1880	9,274	162,575	10½
1881	13,500	348,157	11¾
1882	22,000	697,268	1 0¾
1883	32,000	1,665,768	1 3¼
1884	70,000	2,393,973	1 2¾
1885	102,000	4,372,722	1 3¼
1886	150,000	7,849,888	1 1¼
1887	170,000	13,834,057	1 1
1888	183,000	23,820,723	11½
1889	205,000	34,345,852	11¼
1890	220,000	45,799,519	11
1891	250,000	67,718,372	10
1892	262,000	72,279,985	9½
1893	273,000	82,269,353	9
1894	289,000	85,376,322	8½
1895	305,000	98,581,061	8½
1896	330,000	108,141,112	8¼
1897	350,000	116,054,567	7·71
1898	370,000	110,769,071	7·76
1899	385,000	129,894,156	7·96
1900	392,000	148,431,639	7·20
1901	388,000	146,299,018	6·86
1902	385,000	148,991,241	6·81
1903	386,000	151,120,009	7·52

The industry grew very rapidly, and, as tated above, it commenced to exercise a conderable influence on the English market early twenty years ago, which has ever since continued, until now the combined produce of India and Ceylon has nearly driven China tea out of the market.

This, however, was not done without a very heavy concession in price, Indian and Ceylon tea, as well as China, falling continually in value year after year, until it became a question of the survival of the fittest, and China eventually found prices in the United Kingdom too low to warrant the continuance of large supplies. (See Table V.)

New Markets.

For Indian and Ceylon tea, the matter was different, for at that time they had practically no other outlet, while China had a large market for her teas in Russia and North America, as well as Australia and other places.

These foreign countries were at that time hardly exploited by cultivators of British-grown teas, who naturally sent their produce to London, but it was found that even when China teas had been almost excluded from the home market, there was still too much tea, and the price continued to recede. Hence it became necessary to open up foreign markets with a view to finding further outlets for British-grown teas.

Various efforts were, therefore, made to push our teas in countries outside the United Kingdom, but the necessity for energetically forcing our produce upon these markets was not felt until the struggle to obtain the home market had resulted in seriously reducing the price, and we find that even in the year 1890 only about 14,000,000 lbs. of Indian and Ceylon tea were taken outside the United Kingdom.

It was then beginning to be fully realised that if the industry was to prosper new outlets were absolutely necessary. Hence, efforts were made in all directions to foster a trade wherever tea was being drunk, and as it was found that money was necessary for this purpose, Ceylon planters started a voluntary levy about 1887, and in the year 1893 induced their Government to place a tax upon tea exported from that island in order to provide means with which to push the sale of Ceylon tea in foreign markets. Although this tax was raised by the Government, the proceeds were handed over to the planting community to spend, subject to the approval of Government, in endeavours to force their produce into foreign countries.

India soon afterwards raised a voluntary cess, which continued for some years, until,

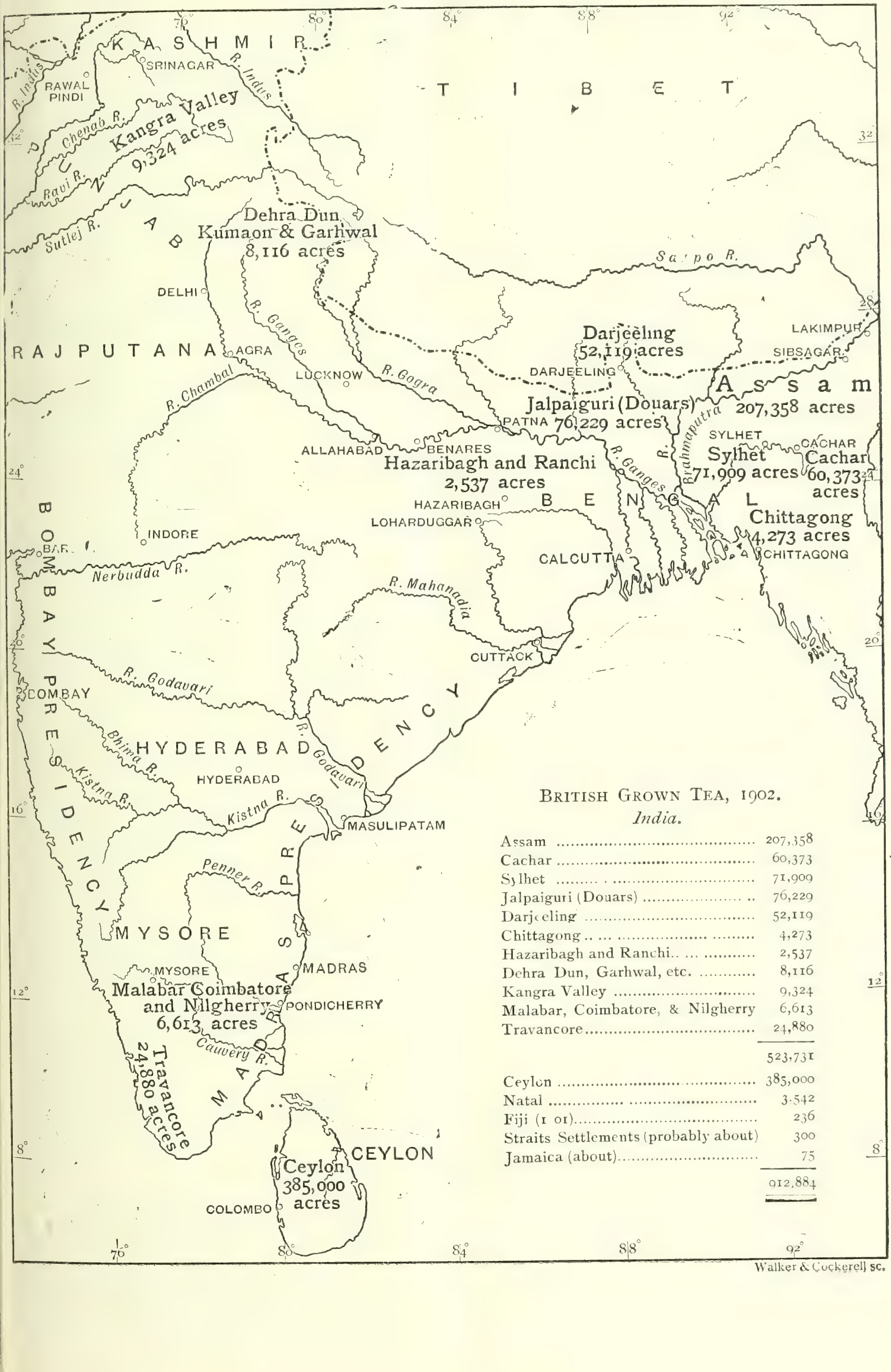
in 1903, under the Viceroyalty of Lord Curzon, a Bill was passed placing a tax on the export of tea for the promotion of its use in foreign markets, and thus the two sister industries were both endeavouring to break up new and for some years afterwards both India a Ceylon employed special commissioners North America for the purpose of watchi their interests and using every opp tunity, by advertising in the newspapers a

TABLE V.—ANNUAL CONSUMPTION OF TEA IN THE UNITED KINGDOM IN LBS. (SHOWING QUANTIT AND PERCENTAGES OF INDIAN, CEYLON, AND OTHER KINDS; ALSO THE AVERAGE ANNU CONSUMPTION OF TEA PER HEAD OF POPULATION).

	China, &c.	Per cent.	Indian.	Per cent.	Ceylon.	Per cent	Total.	Per head of Po in lb
1866	97,681,000	96	4,584,000	4	—	—	102,265,000	3·4
1867	104,628,000	94	6,360 000	6	—	—	110,988,000	3·6
1868	99,339,000	93	7,746,000	7	—	—	106,815,000	3·5
1869	101,080,000	90	10,716,000	10	—	—	111,796,000	3·6
1870	104,051,000	89	13 500,000	11	—	—	117,551,000	3·81
1871	109,445,000	89	13,956,000	11	—	—	123,401,000	3·9
1872	111,005,000	87	16,656,000	13	—	—	127,661,000	4·01
1873	111,665 000	85	20,216,000	15	—	—	131,881,000	4·11
1874	118,751,000	87	18,528,000	13	—	—	137,279,000	4·22
1875	122,107,000	84	23,220,000	16	—	—	145,327,000	4·43
1876	123,364 000	83	25,740,000	17	—	—	149,104,000	4·4
1877	123 300,000	82	27,814,000	18	—	—	151,114,000	4·50
1878	120,652,000	77	36,744,000	23	—	—	157,396,000	4·64
1879	126,340,000	78	34 092,000	22	—	—	160,432,000	4·68
1880	114,485,000	72	43,836,000	28	—	—	158,321,000	4·57
1881	111,715,000	70	48,336,000	30	—	—	160 051,000	4·58
1882	114,462,000	69	50,496,000	31	—	—	164,958,000	4·69
1883	111,780,000	66	58,000,000	33	1,000,000	1	170,780,000	4 82
1884	110,843,000	63	62,217,000	36	2,000,000	1	175,060,000	4·90
1885	113,514,000	62	65,678,000	37	3,217,000	1	182,409,000	5·06
1886	104,226,000	59	68,420 000	38	6,245,000	3	178,891,000	4·92
1887	90,508,000	49	83,112,000	45	9,941,000	6	183,561,000	5·02
1888	80,653,000	43	86,210,000	47	18,553 000	10	185,416,000	5·03
1889	61,100,000	33	96,000,000	52	28,500,000	15	185,600,000	4·99
1890	57,530,337	30	101,961,686	52	34,516,469	18	194,008,492	5·17
1891	52,287,304	26	98,941,931	49	51,227,602	25	202,456,837	5·36
1892	34,483,408	17	109,528,169	53	63,102,127	30	207,113,704	5·43
1893	35,735,722	17	108,143,602	52	64,218,061	31	208,097,385	5·41
1894	25,805,313	12	116,965,653	55	71,570,078	33	214,341,044	5·53
1895	31,433,014	14	116,343,314	53	74,023,809	33	221,800,137	5 65
1896	24,549,936	11	122,941,098	54	80,294,475	35	227,785,509	5 75
1897	21,372,030	9	124,534,194	54	85,493,554	37	231,399 778	5·79
1898	19,512,009	8	133,430,351	57	82,471,745	35	235,414,105	5·83
1899	23,403,946	10	134,018,921	55	85,137,946	35	242,560,813	5·95
1900	19,297,051	8	138,025,026	55	92,470,009	37	249 792,086	6 07
1901	17,087,828	7	147,959 733	58	90,825,521	35	255,873,082	6·16
1902	20,171,477	8	148,727,837	58	85,540,878	34	254 440,192	6·06
1903	26,092,339	10	150,780,655	59	78,492,959	31	255,365,953	6·03

ground, and to increase the sale of their teas in all existing outlets.

In this way advantage was taken of the World's Fair at Chicago in the year 1893, with a view to giving an impetus to the use of our teas in the United States of America, other means, for encouraging the drinking British-grown tea. Strenuous efforts were als made by Ceylon planters to push their produc in Russia, large sums of money being appro priated for this purpose, while other parts Europe were exploited by both India an



BRITISH GROWN TEA, 1902.

India.

Assam	207,358
Cachar	60,373
Sylhet	71,909
Jalpaiguri (Douars)	76,229
Darjeeling	52,119
Chittagong	4,273
Hazaribagh and Ranchi	2,537
Dehra Dun, Garhwal, etc.	8,116
Kangra Valley	9,324
Malabar, Coimbatore, & Nilgherry	6,613
Travancore	24,880
	523,731
Ceylon	385,000
Natal	3,542
Fiji (1 01)	236
Straits Settlements (probably about)	300
Jamaica (about)	75
	912,884

Ceylon, and attempts made to introduce their teas in every available outlet throughout the world.

The result of this was a gradual increase in the consumption of our teas abroad; and whereas in 1890 the total quantity taken was about 14,000,000 lbs., in 1895 it had risen to 37,000,000, in 1900 to 83,000,000 lbs., and last year had reached 119,000,000 lbs.

TABLE VI.—Quantities of Indian and Ceylon Tea (in lbs.) taken by Countries outside the United Kingdom.

	Indian.	Ceylon.	Total lbs.
1890	9,430,942	4,570,190	14,001,132
1891	12,320,344	6,668,921	18,989,265
1892	10,029,328	9,583,285	19,612,613
1893	14,027,129	13,138,544	27,165,673
1894	14,149,904	14,563,082	28,712,986
1895	16,815,323	19,923,803	36,739,126
1896	19,206,172	23,465,733	42,671,905
1897	22,413,511	29,131,021	51,544,532
1898	25,960,405	36,066,888	62,027,293
1899	29,570,173	38,438,509	68,008 682
1900	33,442,970	49,259,693	82,702,663
1901	36,080,151	58,797,549	94,877,700
1902	42,361,366	64,374,989	106,736,355
1903	47,588,221	71,592,169	119,180,390

It was only natural that amongst the first to take large quantities of our tea should be our own colonies; hence we find that Australasia, which in 1890 took about 26,000,000 lbs. of China tea, gradually displaced this by the use of tea from our own dependencies, until at the present time about 80 per cent. is British grown.

Canada has also proved a fruitful colony for the consumption of our produce.

Russia was found, for many years, very difficult to deal with, but at length seemed to take slowly but surely to Ceylon teas, until in the year 1900, a sudden and rapid growth occurred, Russian houses having already started agencies in Colombo, with the object of purchasing Ceylon teas. A year or two afterwards, Indian tea obtained a firmer hold upon Russia, and both kinds are now making rapid progress, the important quantity of something like 35,000,000 lbs. being taken last year.

Turkey at one time took a fair supply of Indian tea, but the trade has not gone ahead there as it was at one time expected.

In the United States of America, far more green and uncoloured tea is used than bla[ck] tea, and after a few years it was found that t[he] small proportion of the population who to[ok] China black tea, was partially converted fr[om] that to the use of Indian and Ceylon, and [as] the field for an increase in this became smalle[r] it soon became apparent that if the Nor[th] American market, as a whole, was to be ca[p]tured for our tea, determined efforts must b[e] made for the possession of the market for gre[en] and uncoloured tea. Hence Ceylon planter[s] out of the tax raised by Government, decide[d] to give a bounty for making suitable gree[n] or uncoloured tea. This resulted in sma[ll] quantities being manufactured; and a trad[e] gradually grew up until last year the bount[y] was paid on 11,119,766 lbs., and a large mark[et] has at last been found in North America an[d] Canada for this class of tea.

India did not start a bounty until the yea[r] 1901, and is now turning out rather more gree[n] tea, bounty last year being paid on 1,891,91[...] lbs.

The St. Louis Exhibition, which has jus[t] been opened, is being taken advantage of wit[h] the object of further stimulating the drinkin[g] of British-grown tea in the United States. A considerable sum of money has been laid ou[t] by both India and Ceylon, and Commissioner[s] appointed to use every endeavour to promote th[e] interests of those countries, and it is hoped tha[t] as this particular locality is a large user o[f] green tea, that grown in our dependencies may derive much benefit from the exposition.

India has just offered a bounty for the manufacture of Oolong tea in the hope of making a suitable kind for consumption in North America, where a large quantity of this class of tea is annually consumed. If this and the green tea market can be captured for our teas, a very large additional field will be at our feet.

Considerable attention has been given during the last few years to opening up a market for Indian tea amongst the natives of India. This movement was helped by the attention which Lord Curzon drew to the subject some three years ago; and pronounced efforts have since been made to induce tea drinking among the natives. This appears to be now bringing forth some fruit, and consumption is showing signs of growing. (See Table VII.)

Increase in Production.

The growth of the Indian and Ceylon tea industries may be illustrated by the fact that in the year 1875 there were 125,000 acres under cultivation in India, in 1885 284,000 acres, and

TABLE VII.—INDIAN AND CEYLON TEA (IN LBS.) TAKEN OUTSIDE THE UNITED KINGDOM DURING EACH OF THE LAST FOURTEEN YEARS.

Indian.

Country.	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
Australasia	5,118,714	5,203,995	3,908,087	6,239,538	4,871,919	6,537,692	5,632,948	7,093,948	6,257,281	8,772,050	9,578,626	9,167,795	5,206,400	6,330,618
North America	1,403,914	1,517,114	1,608,150	2,152,333	2,356,954	4,049,419	5,316,530	5,663,244	5,971,701	8,487,443	6,958,370	7,026,773	12,136,587	12,097,220
Turkey, with Persia	1,681,157	4,112,037	2,284,271	3,627,623	5,150,722	4,572,147	5,473,[illegible]92	3,548,156	7,455,095	6,[illegible]87,919	7,714,349	7,262,064	7,769,878	8,156,490
Russia, with Germany	201,282	303,935	468,047	469,493	632,398	713,270	960,369	2,790,962	3,545,184	3,3[illegible]5,173	5,585,926	7,498,270	10,080,790	15,138,130
South America	73,117	65,222	91,982	120,613	180,880	250,000	350,000	319,927	360,464	497,336	602,867	693,474	754,424	1,201,185
Holland	323,122	423,241	510,906	281,038	297,065	357,035	416,713	522,110	474,509	486,103	483,975	754,311	1,041,641	919,244
South Africa	105,460	103,610	246,504	215,338	174,500	226,2[illegible]8	284,617	56[illegible],693	539,410	470,281	1,273,484	2,263,105	2,415,401	1,401,661
Denmark	Not stated.	Not stated.	Not stated.	Not stated.	Not stated.	Not stated.	91,230	91,111	238,670	197,646	96,016	127,551	117,485	182,976
France	50,311	51,159	59,218	48,745	52,892	66,002	60,1[illegible]6	59,954	81,258	65,296	112,873	99,364	82,403	113,527
Belgium												147,313	139,129	126,706
Egypt												122,244	297,050	261,097
Austria-Hungary												72,225	56,734	40,582
Brit. W. Indies												70,668	78,809	86,743
Roumania												42,865	41,580	18,529
Norway and Sweden	473,865	539,991	852,163	872,408	867,250	602,891	390,841	1,758,406	1,036,827	887,926	946,484	42,197	50,228	59,697
Portuguese E. Africa												40,428	59,701	73,567
Gibraltar, Malta & Gozo												47,361	71,011	75,4[illegible]0
Channel Islands												406,447	428,588	505,499
Brit. E. Indies												—	—	18,046
Other Places												195,696	1,758,126	771,508
Total lbs.	9,430,942	12,320,344	10,029,328	14,027,129	14,584,580	17,374,684	18,976,716	22,413,511	25,960,405	29,570,173	33,442,970	36,080,151	42,585,965	47,587,435

Ceylon.

Country.	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
Australasia	2,559,901	3,210,598	5,002,386	6,968,956	7,446,782	9,379,561	11,062,832	13,258,456	15,126,891	15,606,833	17,606,912	20,652,804	18,718,794	19,759,353
North America	829,408	1,155,116	1,489,474	1,870,589	2,295,147	3,659,381	4,364,510	5,698,596	7,636,995	8,192,832	8,495,288	10,448,969	14,572,747	20,912,445
Turkey, with Persia	151,226	638,363	563,945	985,064	900,993	875,177	955,998	1,246,594	1,439,473	824,385	1,256,306	1,218,393	1,016,123	577,956
Russia, with Germany	486,195	710,551	1,193,538	1,708,233	2,059,131	3,400,944	3,824,083	5,749,558	8,249,482	9,958,673	16,495,783	20,104,877	23,170,841	23,235,596
South America	61,446	111,346	155,131	259,056	275,276	450,641	588,115	390,477	435,231	504,579	759,841	913,507	1,10[illegible],9[illegible]3	1,593,767
Holland	131,575	156,275	202,856	190,832	215,298	232,505	349,262	281,821	281,536	309,149	313,993	527,150	349,626	350,817
South Africa	52,559	83,583	200,113	183,285	181,123	267,828	325,730	806,585	1,109,474	778,761	1,311,730	2,150,338	2,602,740	1,691,[illegible]81
Denmark	Not stated.	Not stated.	Not stated.	Not stated.	Not stated.	Not stated.	285,272	169,619	286,361	315,065	102,820	128,894	140,788	159,731
France	30,269	64,591	60,911	87,639	100,085	134,432	147,485	166,490	189,208	182,8[illegible]9	459,9[illegible]1	422,164	330,129	567,517
Belgium												180,022	289,124	333,631
Egypt												33,677	31,147	[illegible]5,233
Austria-Hungary												90,2[illegible]4	96,017	115,478
Brit. W. Indies												155,468	153,652	152,970
Roumania												36,378	29,020	31,255
Norway and Sweden	267,611	538,498	714,931	884,850	1,081,427	1,508,918	1,462,879	1,362,825	1,312,237	1,675,413	2,457,109	233,765	265,255	270,000
Portuguese E. Africa												56,938	62,264	58,202
Gibraltar, Malta & Gozo												524,301	504,045	553,167
Channel Islands												525,965	535,007	410,601
Brit. E. Indies												—	—	—
Other Places												393,675	737,687	820,051
Total lbs.	4,570,190	6,668,921	9,583,285	13,138,544	14,555,262	19,909,387	23,366,166	29,131,021	36,066,888	38,438,509	49,259,693	58,797,549	64,707,999	71,619,101

in 1902 525,000 acres. In Ceylon in the year 1880 there were 9,000 acres, in 1890 220,000, in 1900 384,000, and last year 386,000.

Amongst districts more recently planted up with tea the most noticeable is Travancore, where large acreages were opened some six or seven years ago, especially in the higher slopes of the Kanan Devan Hills. Some of these teas possess good flavour rather after the style of those from Ceylon; production has rapidly increased lately, and last year the export was over 8,000,000 lbs. Tea has also been recently planted in the Wynaad.

Production in both India and Ceylon thus made steady progress, for, as already stated, the tea of each was readily taken in Great Britain, while some external markets also gradually substituted our teas for those of China. As it could be grown at a profit, and its consumption was found to increase rapidly, it was only natural that large areas of land should be placed under cultivation.

Fall in Silver.

There was also another factor influencing the production of tea, and that was the heavy fall in the value of silver. This tended to increase production in India and Ceylon, because the currency there is silver, and the tea was mostly sold in Great Britain, where there is a gold currency. With the gold received as proceeds of the tea sold in the United Kingdom silver rupees were bought to pay for the labour, &c., necessary for the up-keep of tea estates. As the price of silver fell, more rupees could be purchased for the same quantity of gold; thus when the rupee was worth 2s. only *ten* could be purchased for £1, but when it fell to nearly 1s. about *twenty* could be purchased for £1. Consequently as the rupee fell in value cultivation became cheaper every year. This went on until the beginning of 1895, when the value of the rupee was as low as 1s. 0½d. But owing to this decline in the price of silver, the Indian Mints were closed in 1893 in order to fix the value of the rupee at about 1s. 4d. This had the effect of raising the price of the rupee in India and Ceylon, and thus materially increasing cost of production; but the mischief as regards tea had already been done. When the exchange dropped large tracts of land were planted up, in the belief that the value of the rupee would be regulated by its intrinsic value, and the rise to over 1s. 4d. was a severe blow to tea production, owing to the greatly increased expense in cultivation.

There was another reason why the rupee thus becoming a token and not representing its intrinsic value militated against the industry, viz., that a country with a silver currency, especially China, where the dollar is only worth its value in silver, was placed in a more favourable position as regards production. It is a wonder, therefore, that in spite of the industry being so handicapped as compared with China, our teas should have still continued to displace theirs not only in our own but also in foreign markets. Other influences besides the rupee interfered with the prosperity of tea production.

Rise in Duty in 1900.

The duty in this country from 1865 to 1890 stood at 6d. per lb., a heavy burden on the industry. It then was reduced to 4d., and, curiously enough, immediately the tax was lowered a rise in the value of tea took place. The 4d. duty remained until the outbreak of the Boer War, when in 1900 it was raised to 6d. as a war tax, this being immediately followed by a further depression in prices.

Without going into the merits of the fiscal question, it is quite intelligible that as long as tea was not grown by our fellow-subjects but by foreigners it should have been taxed, but when its production was so largely in the hands of our countrymen, as has been the case for the last twenty to thirty years, it is somewhat strange that the taxation should have still continued so heavy, and that it should have been impossible to find some other product upon which an impost could be levied which was not so largely grown by our fellow subjects. With the duty raised to 6d., tea was taxed to the extent of not far short of 80 per cent. of its value, a burden which is admittedly a very heavy one. In addition to this, a differential duty was last year placed upon tea by the Russian Government, which will not now permit tea from British dependencies to enter by the European frontiers without charging it 1d. per lb. above that paid by teas of any other nation.

TABLE VIII.—Approximate Duty on Tea Levied in Different Countries per English Pound.

Argentina	4½d.
Australia	Free.
Austria-Hungary......	9¾d.
Barbados	3d. and 20% ad.
Belgium	Free.
Bermuda	5% ad. val.
Brazil................	50% ad. val.
Bulgaria.............	14% ad. val. & 4¼d. excise

Canada	*Free from country of production and U.K. Otherwise* 10%.
Cape Colony	4d.
Chili	9d.
Denmark	4d.
Egypt	8% ad. val.
France	9d.–11¾d.
Germany	5½d.
Great Britain	8d.
Greece	1¾d.
Holland	2¼d.
Honduras	2½d.
Italy	11d.
Jamaica	1s.
Mauritius	About 3d. and 4% ad.
Morocco	10% ad val.
Natal	4d.
Newfoundland	33% ad val.
New Zealand	2d.
Norway	1s.
Orange River Colony	4d.
Persia and Arabia	About 4¼d.
Peru	65% ad. val. and 10%.
Portugal	2/0½d.
Roumania	3¼d. and 4¼d. excise.
Russia	2¾d.–1/11¼d.
S. Rhodesia	4d.
Spain	6½d.
Straits Settlements	Free.
Sweden	3d.
Switzerland	2¼d.
Tasmania	Free.
Tobago and Trinidad	6d.
Transvaal	4d.
Turkey	8% ad. val.
Uruguay	5¾d. and 5%.
U.S. America	Free.
Venezuela	6d. and 30%.

Over-Production.

So long as the use of China tea in this country could be displaced by that from India and Ceylon, the latter growths annually increased largely in consumption, as already stated, but there came a time when the use of the China produce was reduced to a minimum; this was about 1897-8, and as, in spite of all the efforts being made, markets outside the United Kingdom although gradually expanding, only took a few million pounds more of our teas annually, this was not sufficient to absorb the surplus production. Consequently the output from the large areas which had been placed under cultivation soon led to over-supply, while the increased cost of production owing to the rise in the rupee caused by the closing of the Indian Mints, the working of which I have tried to explain, was such that, about 1898-99 many estates showed little or no profit. During the next few years the condition of the tea-producing industry became critical. The very large areas which had been planted out in 1897-98 were now coming into bearing, and the crops from both India and Ceylon were unmanageably large, and many estates could hardly meet their expenditure. This trouble was intensified by the increase of the duty from 4d. to 6d. per lb. in 1900; and the ultimate effect of these three causes was that a good deal of poorer land had to be abandoned, and although the greatest economy was practised wherever possible, the crisis became so severe that, unfortunately, numbers of European assistants and even managers were obliged to submit to considerable reductions in salaries, while many were also thrown out of employment; many estates became hopelessly involved, and several large companies had to be reconstructed with severe loss to the shareholders.

Table IX.—Table showing the Annual Export of Tea from India and Ceylon—also the Annual Consumption of Indian and Ceylon Tea in the World—as nearly as can be ascertained—thus illustrating the extent of the recent overproduction.

	Export from Countries of Production.	Total Consumption.	Surplus Production.
1895	233,834,519	227,806,249	+ 6,028,270
1896	253,141,438	246,607,478	+ 6,533,960
1897	268,865,989	261,875,872	+ 6,990,117
1898	276,437,473	278,629,389	− 2,191,916
1899	302,590,293	287,965,547	+ 14,624,746
1900	334,113,050	314,097,698	+ 20,015,352
1901	327,138,679	334,662,954	− 7,524,275
1902	329,112,682	342,005,070	− 12,892,388
1903	354,488,547	349,454,004	+ 5,034,543

Improving Prospects.

Happily the tide began to turn towards the end of 1902, when most of the land planted out had come into bearing, and in consequence production began to increase less rapidly, consumption all over the world still continuing to grow, although at home more slowly than usual, owing partly to the increased duty. Still prices, which had commenced to rise in 1902, remained on a higher level, with the result that the season proved more beneficial to producers than had been the case for some time, while during the year 1903 results were on the whole somewhat better. This was mainly the case

with estates producing such teas as make up the great bulk of the consumption at home —viz., those of the grade which can be sold to the public at a comparatively low figure. The rise in price of these had become very marked, owing to the strong demand from the public at home for cheap teas, together with the fact that the output of black tea had been reduced by the manufacture of several million pounds of this class of tea into green, thus materially reducing the output of tea of lower quality.

The Recent Rise in Duty.

This was the position at the close of last year, but since then the industry has experienced another and most unexpected blow in the addition of a further 2d. per lb. to the duty in the United Kingdom, thus taxing tea in the home market over 100 per cent. of its value. What the effect of this new burden may be it is as yet too early to say with certainty, but there seems no doubt that it must either check the consumption or the producer must take a lower price. Coming as it does at the present time, when almost the whole of the Indian crop for 1903 has been sold and while the imports from Ceylon are not very heavy, its *immediate* effect upon the market is not as serious as would have been the case had it come when the bulk of the crop was unsold.

So far, the effect has been to raise the price of the lowest kinds of tea, and to cause a somewhat slacker demand for better grades. The reason of this is doubtless that the public do not wish to pay more for tea than they have been accustomed to, and will probably buy a lower quality, where possible, rather than pay an increased price. This is unfortunate for the tea producer, as it may lead to the importation of cheaper and inferior kinds of China tea.

It is probable that the full effect of the additional impost will not be felt until the arrival of the Indian crop next autumn, up to which time there should be comparatively little tea for sale on the London market. Should the coming crops from India and Ceylon prove to be moderate in size prices may be no worse than they are at present, but if the season should be favourable to a large output of leaf, or coarse plucking should be resorted to, we may again have to face a reduction in values.

It is at any rate most unfortunate for tea producers that yet another burden should be added to the heavy load already placed upon them, and we must hope that it will not be long before a material reduction takes place in the duty.

Should this prove to be the case there is reason to hope that the industry may soon become more prosperous, because practically all the heavy acreages planted up six or seven years ago are now well in bearing, and as very little new tea has been planted since then owing to the recent unsatisfactory condition of the industry, no large increase under ordinary circumstances is likely for some years, because tea takes four to five years after it is planted before it begins to produce any appreciable quantity of leaf. Hence unless coarse plucking be resorted to, or the seasons in India or Ceylon during the next few years should prove of an exceptionally forcing character for growth of leaf, it is unlikely that any large increase in supply can take place. So much for production.

As regards consumption, although no immediate increase seems probable in the home market, owing to the increased duty, which indeed may even cause less tea to be used, it is at least permissible to hope that so heavy a tax will not be of long duration, and with some of the pressure removed we may again return to something like our normal increase in production, which, before the duty was raised to 6d., averaged about $4\frac{1}{2}$ million lbs. per annum.

But foreign markets present a more hopeful outlook. They are taking annually larger quantities of our tea, the increase in 1903 being 12,000,000 lbs. above 1902, while in 1902 it was 12,000,000 lbs. above 1901. Hence the world's consumption seems likely to expand.

Given these two conditions some advance may take place in prices, and more remunerative results accrue to tea proprietors and shareholders during the next few years unless, indeed, producers should again be sufficiently unwise to open up areas too quickly for the demand. (See Table X.)

Investment in Tea-producing Companies.

Speaking of the present condition of the industry, and the vicissitudes through which it has passed during the last eight or nine years, leads one to think of tea as an investment. Some ten years ago, when tea was looking well, the public began to make investments in producing companies to a greater extent than ever before, and by about 1897-8 tea companies became in such favour that the demand

TABLE X.—CONSUMPTION OF TEA IN ENGLISH POUNDS IN VARIOUS COUNTRIES.

	Average, 1880–84.	Per head of Population.	Average, 1885-89.	Per head of Population.	1890.	1894.	1899.	1902.	Per head of Population, 1902.
Australia	18,200,000	7·66	21,488,920	7·66	21,253,186	23,708,638	27,347,192	22,191,255	6·15
New Zealand	3,902,000	7·23	4,337,453	7·19	3,849,105	3,667,785	4,799,000	5,210,375	6·74
Tasmania (about)	699,500	5·35	907,035	6·37	977,864	924,888	1,077,632	1,203,091	7·00
Great Britain	170,733,600	4·70	183,153,080	4·91	193,949,452	214,341,044	242,561,000	254,440,192	6·02
Newfoundland	824,000	4·38	852,073	4·41	871,281	970,850	1,031,652	955,980	4·41
Canada	16,600,000	3·69	18,849,450	3·90	18,455,475	20,551,739	25,056,000	19,682,053	3·66
United States	71,175,314	1·20	79,173,100	1·34	83,494,956	91,801,565	72,836,000	78,826,072	1·03
Holland	4,860,373	1·16	5,173,694	1·16	5,615,763	6,600,876	7,073,000	7,997,470	1·51
Cape Colony	1,128,500	0·90	1,169,892	0·85	1,464,109	1,787,785	2,117,471	4,962,047	2·04
Natal	327,300	0·76	540,832	1·13	520,787	277,220	484,486	1,172,650	1·26
Russia	62,403,500	0·61	70,543,866	0·77	73,661,760	88,744,284	104,436,000	157,803,520	1·23
Denmark	733,800	0·37	798,306	0·37	752,957	938,788	986,290	1,003,476	·41
Uruguay, 1884	176,930	0·34	203,419	0·29	174,855	189,741	169,522	Not stated.	—
Argentina, 1883-84	900,000	0·30	1,118,135	0·28	1,121,960	1,265,600	1,534,764	Not stated.	—
Portugal	561,000	0·12	589,136	0·13	642,675	623,772	584,943	642,412	·13
Switzerland, 1880-82	292,000	0·10	287,274	0·10	185,158	524,563	681,478	730,262	·22
Norway	170,400	0·09	183,082	0·10	196,548	226,240	275,500	(Estd.) 277,760	·12
Germany	3,113,500	0·07	3,975,882	0·08	4,595,340	6,247,494	6,039,000	7,509,407	·13
Morocco (about)	345,000	0·06	744,873	0·10	856,750	206,950	445,606	998,704	·12
Belgium, 1883-84	155,896	0·03	135,379	0·02	127,135	170,588	649,393	558,958	·08
Sweden, 1880 83	139,250	0·03	198,796	0·04	259,196	350,649	444,125	444,420	·08
France, 1882	1,029,561	0·03	1,168,317	0·03	1,355,663	1,527,680	1,947,000	1,761,419	·04
Austria-Hungary, 1883-84	739,500	0·02	1,071,925	0·03	1,263,889	1,880,771	2,051,703	2,260,524	·04
Bulgaria, 1884	33,669	0·02	63,008	0·02	123,332	215,219	82,716	127,967	·03
Spain, 1884	136,000	0·01	224,720	0·01	201,101	231,024	145,259	292,628	·01
Jamaica	—	—	—	—	—	—	47,958	51,267	·06
Bermuda	—	—	—	—	—	—	90,720	119,337	6·86
Mauritius	—	—	—	—	—	—	130,307	97,372	·25
Honduras	—	—	—	—	—	—	27,469	Not stated.	—
Barbados	—	—	—	—	—	—	55,850	59,129	·30
Tobago and Trinidad	—	—	—	—	—	—	66,270	81,506	·29

for shares had driven quotations to almost a 5 per cent. basis for ordinary shares, while the preference shares were raised to a price giving considerably less return for money invested. Then the bad years came on with gradually dwindling dividends, resulting in a complete stagnation of the tea share market. Securities were very difficult to dispose of, there were hardly any buyers, and few holders cared to face such low prices as were offered. But, about two years ago, people understanding the improved position, began quietly purchasing shares, and consequently raised values to some extent. At the present time prices, although materially above the lowest point, are nothing like as high as they were seven or eight years ago, while with the improved prospects referred to above, a fair return seems probable for investment in well selected tea-producing companies.

Some Recent Events.

The partial opening of the Assam-Bengal Railway, a few years ago, made a considerable difference to proprietors of tea estates in the Brahmapootra and Surmah valleys, and diverted gradually increasing quantities of tea from Calcutta to Chittagong, as their port of shipment, while it also occasioned a reduction in the cost of bringing tea down the Brahmapootra and Surmah rivers by steamer. When this railway is completed, it should still further reduce cost of production over a large portion of the tea-growing area in Northern India.

Efforts have also been made in recent years, both in India and Ceylon, to deal with cultivation and manufacture in a more scientific manner, the investigations of practical chemists being brought to bear upon the cultivation and manufacture of the plant, the fruits of which will probably lead, before long, to material changes, as well as to a better understanding of the blights and pests to which the plant is liable, and, therefore, in all likelihood, to a warding off of the perils liable through these causes.

Labour Difficulty.

One of the greatest difficulties the Indian tea industry has to deal with at the present time is scarcity of labour, together with the heavy expense of obtaining coolies. Unless some means can be found to in some way attract native labour to tea estates, production may suffer during the next few years. This difficulty is specially pronounced in the province of Assam, but is becoming acute in other tea districts in India, and is now being seriously felt in Ceylon also.

Russo-Japanese War.

It is impossible to say how the present war in the Far East may affect the British-grown tea industry, but as Japan exports annually some 60,000,000 lbs. of tea, there is a possibility of some reduction in this quantity in the event of labour being drawn from the tea districts. In this case the introduction of Indian and Ceylon green and Oolong teas into the North American market would probably be more easy and more rapid. The fact that Russia has lately taken large quantities of tea through Dalny in order to cultivate the traffic on the Siberian Railway which can now no longer take place, naturally affects the situation of British-grown tea, as the large Russian market must now be supplied mainly through the European frontiers. Still these are questions for the future, and it is impossible as yet to forecast the result. From the above causes, as well as a probable increased demand from America, it seems that in the event of any shortage in the supply of Japan teas, the British-grown tea industry is likely to receive more benefit than otherwise from these unfortunate hostilities.

Demand for a Cheap Canister.

The gradually increasing quantities of tea which have come to the London market, and which have caused such rapid reductions in price, have brought it more and more within the means of the poorest of the community, and as a result it has become almost a necessity in every household.

This led to a demand for cheaper kinds of tea, and the fashion now seems to be for everybody, in almost every class of life, to pay as low a price as possible. This is a mistake, because the cheapest tea is not always the most economical, and if the public would only realise the fact that better value as well as better flavour can be obtained by paying a higher price, they would find they need not use so large a quantity, and that, in addition to securing a far more palatable beverage, there would be a probable reduction in their household accounts.

During the past year or two the demand for low-priced tea has led to the importation into the United Kingdom of a considerable quantity of common China tea which had actually been rejected in the United States, and yet found its way into this country as an article of food. The

Indian and Ceylon Associations have made strong representations to Government on this subject, but so far without effect. Some legislation seems necessary to prevent the importation of tea of very low quality.

I have tried to show you some of the vicissitudes through which British tea production has passed, and to trace its history during recent years.

You have seen that it has had some rough times to go through, that planters have had to struggle against keen competition, adverse legislation, high duties, and low prices; that their hard fight for new markets has borne good fruit, and indeed almost proved their salvation.

The industry has done good service to its country. It maintains something like one million of our native population in India and Ceylon, and furnishes lucrative employment to thousands of our own fellow-countrymen, thus being of material assistance in finding occupation for the younger generation. So many families in various grades of society have relatives engaged on tea plantations, and have contributed to their welfare by using at home the product of their labour abroad, that the industry has done much to promote a feeling of mutual dependence between the mother country and her sons across the seas, and in this way to draw still closer those natural ties, which cause the different parts of the British Empire to think so affectionately of the parent home.

May the industry long continue to prove a bond of union between the mother and her daughter colonies, and thus a continuous source of unity and strength to our much-beloved Empire.

DISCUSSION.

The Right Hon. Sir J. West Ridgeway, G.C.M.G., K.C.B., K.C.S.I., thought the members of the Society ought to be very grateful to the author for his able and lucid paper, and for the attempts he had made, which they hoped would be successful, to enlighten the British public on behalf of the great British tea industry, which had been rather harshly treated, and to enlist their sympathy. He considered that England ought to be proud of its tea industry. The history of that industry in Ceylon was like a romance. They all knew how the coffee industry sprang up and flourished, until suddenly it was ruined and devastated by a visitation of heaven, not by a visitation of the Chancellor of the Exchequer. The planters of Ceylon did not take it "lying down"; they struggled and fought and created another considerable industry, the great tea industry, which had made Ceylon so prosperous, and given the Government of Ceylon the money wherewith to construct its railways, its irrigation works, its harbour works, and to supply many wants of the people. It was, therefore, natural that he, who had governed Ceylon for eight years of prosperity, should regard anything which menaced the interest of its staple industry as threatening the prosperity of that beautiful island itself. Naturally on such an occasion a speech with regard to tea tended to begin and end with a grumble about the tea duty. Before he began that grumble he wished to refer to one point which had not been touched on by the author, and which must suggest itself to intending investors, namely, why should not the fate of coffee overtake tea? He did not think it was at all probable. The tea plant was much more hardy and sturdy than the coffee plant, and, under favourable climatic conditions flourished in any soil which was deep enough for its long root. Rainfall did not hurt it. The alternations of rain and sun in Ceylon and Assam were very favourable to tea. Harvesting was practically spread all over the year and not at one time, as in the case of coffee, when untimely rainfall might ruin the crop; and altogether there were many advantages which made tea safe from the fate of coffee. Another great advantage which tea had was that its cultivation was very much more scientific than the cultivation of coffee used to be. Nowadays science was necessary in all things if one wished to be successful, and for that reason the Government of Ceylon had attached to the Royal Botanical Gardens at Kandy a scientific staff, consisting of an entomolgist, a mycologist, and an agricultural chemist, who were a bureau for informatian regarding the agriculture, the horticulture, the entomology and the plent pathology of the island. It was their duty to tour about and examine the crops, to study the appearance and conditions of any pest, and to give advice as to how that pest should be treated and extirpated. By legislative enactment, all plants, fruit, and seed introduced into Ceylon had to be fumigated. Further legislation was in contemplation, which depended on the feelings of the planting industry, whereby any estate on which pests had appeared should be registered, and the distribution of tea from that estate forbidden until it was certified to be free from disease. Thus it would be seen that the planter and the Government had done all they could for tea, and he believed that the prosperity of the industry was assured, if only the Chancellor of the Exchequer would keep his fingers off. The author had alluded to the vicissitudes through which tea had passed, first of all with regard to the silver question. The Government of India, by placing an artificial value on the rupee, inflicted a loss on the tea planter in favour of China, where the dollar was maintained at only its intrinsic value. He did not question that policy, because he believed it was a wise and necessary policy. The boom which took place in consequence of the deterioration of silver caused over produc-

tion, which reduced profits sometimes to almost zero. But the planter rose to the occasion; by economy, by reducing the cost of production, by restricting the output, and, above all, by finding new markets, such as Australia, the United States, Canada, the Continent of Europe, and especially Russia, he almost restored prices to their former level. Then his misfortunes began. In consequence of English policy—again he did not question the wisdom of the policy—regarding sugar and the interest of the West Indian colonies, Russia clapped a retaliatory duty on tea. The author had mentioned the doleful history of the tea duty. It was 4d. when war broke out, and it was raised another 2d. Not a murmur was heard from the planters; they recognised their Imperial obligations, and not only did they submit but they equipped and sent forth hundreds of young men to fight the battle of the Empire. But they did hope and expect that when the war was over the duty would be remitted. It had not been remitted, it had been doubled, and what they said was that the burden was too heavy for the industry to bear. Prices had risen and, therefore, consumption must be checked. There, again, China scored, because people rather than pay a higher price for their tea would use those cheap rubbishy teas which Mr. Wylie had in his mind when in the House of Commons recently he indulged in his diatribe on tea. With regard to the action that should be taken by those interested in tea, he (Sir West Ridgeway) advised them to restrict the output and to make it as costly as possible without playing into the hands of China. When the man in the street realised that he had to pay more for his tea they might be sure of his practical as well as his academic sympathy.

Mr. H. K. RUTHERFORD (President Ceylon Association in London) said:—I can only echo what Sir West Ridgeway has said regarding the interesting paper we have listened to from Mr. Stanton. It was the Chancellor of the Exchequer, or some other important member of the Government, who said in the House, during the debate on the tea duty, that the people of the country are "saturated" with tea. That is a matter of opinion, for as we have been told by Mr. Stanton that this country consumes 6 lbs. per head, against Australia's $7\frac{1}{2}$ lbs., then if we are "saturated," what term can be applied to them? It might make a very good "Missing Word Competition!" There is one thing, however, that those whose business it is to have anything to do with tea companies in London have, during the last fortnight, been mentally saturated with, as this is the time for holding the annual meetings of such concerns, and we took a regular plunge into the fluid last week at the meeting of protest against the tax. Notwithstanding this, here we are once more coming up to this afternoon's symposium on tea as if nothing had happened. The planter's life is one of strenuous exertion. He is continually fighting against enemies, seen and unseen. In his cultivation he contends against all sorts of insect pests and fungoid growths, blights and cankers. He is continually warring against the elements, and China tea, and he is now engaged in fighting his own Government, who has got him by the throat. Compare his life with, say, that of an Essex farmer. What would the agriculturist here say if on a 400 acre farm he had to constantly employ 500 hands, look after their daily work, settle family disputes and medical wants, house them and provide food for them, keep elaborate estate accounts which are models to all agriculturists, and carry on the work of a factory; all this in a tropical sun. We have two kinds of Imperialism—the after-dinner kind, of hands across the sea, one for all and all for each, and the commercial Imperialism, which is, as you know, such a different kind.

Mr. F. A. ROBERTS (Vice-Chairman Indian Tea Association) said his own small part in the world of tea was associated with India, and more particularly Assam, and the remarks which he had to make he proposed to confine to that province. But, it was a large and important province, and it could well occupy their attention for the few minutes that he could devote to it. His own connection with it extended over some twenty years only, but the business with which he was particularly connected went back to the fifties, and that was going back practically to the pioneering of the tea industry. It was interesting to look back to those early times and to compare them with the present. What was the condition of Assam in those days? A province of India almost cut off from the rest of the world, for it took some two or three months to get there from Calcutta, most of the journey having to be done in a native boat. And what was to be found when the destination was reached? A huge waste of jungle, lightly dotted with clearances of cultivation, a country almost bare of inhabitants, for the original Assamese had been almost wiped out by the continual raid of the hill tribes, which had almost decimated them; the means of transit nothing but the back of an elephant, through practically tractless wastes. The very means of subsistence were hard to get, and the shelter nothing but the rudest native-built huts. And when one contemplated what these early pioneers were working for, one stood entranced at their endurance, their pluck, and their self-reliance. For they were not prospecting for gold, or for anything which, by a lucky stroke, could make their fortune in a day, and enable them to leave those jungly wastes; they had to settle down to reclaim those lands from primeval jungle to cultivate them, sow them, and wait some three or four years before any return could be expected from their toil. And in this respect their difficulties began early, for the question of labour was soon to be encountered. With a country so sparsely populated difficulties almost at once arose, sufficient to damp the ardour of the most enthusiastic. But these were overcome, labour was imported from Bengal and other provinces, at great

pense and with weary weeks of waiting, and in course of time Assam began to take on a different aspect. And then came further trials, brought about by ignorance and want of experience—which had to be dearly bought. With insufficient labour and adverse weather conditions, their crops failed, until. as Mr. Stanton had told them, in the early sixties a crisis was reached, and all seemed to be at an end. But the hearts of these early pioneers never failed them, and they set to work to retrieve their fortunes by sheer hard work and common sense, and fortune at last seemed to favour them. The province got opened out, the means of transit were improved, a ready market was found for their produce, and they began to reap the reward of their toil. There were still ups and downs of fortune to be encountered, which meant fat years and lean years, but on the whole they prospered, and things went well. To come down to the nineties, matters had reached a different crisis and tea was booming. And then what happened? The money which was being made attracted capital. Capital was poured into the industry. Estates were bought up, land was acquired, cleared, and opened out, until wise men shook their heads and wiser men sold out, foreseeing a time of stress and trouble. For a few years the pinch was not felt, for the new tea lands had to come into bearing, but eventually the inevitable was reached and over-production was rampant. Then came a time of positive distress, which was sorely felt by the small estate owners, many of whom had to go under, practically ruined, but the industry did not fail, for there was capital behind it. Ceylon, too, became a factor to be dealt with, and the marvel was that the world could consume all the tea produced. By strenuous efforts, tea was pushed in all parts of the globe, and even the difficulties of over-production appeared to be yielding to treatment. And now let them, for a moment, compare Assam present with Assam past. The jungle had given place to acre upon acre of well-trimmed tea bushes, and that fertile valley of the Brahmapootra was a picture worth seeing. A tea estate, with a new flush, ready to be plucked, was a fine sight, the fresh green shoots reminding us of our own spring tints. The neat bungalows of the managers, with their well-kept flower and vegetable gardens round them, the trim looking factory buildings, well-arranged and supplied with the most up-to-date machinery which modern invention could supply, were all worthy of note. But trials had still to be met, a sudden hailstorm might devastate that sheet of unplucked leaf and strip the bushes like bullets from a Maxim gun; an attack of blight might turn the leaves a reddish brown, giving them the appearance of having been scorched, or a cyclone might wreck those houses, and tear off iron roofing like sheets of paper. A sudden epidemic might affect the labour force, and give the manager anxious thought as to when and how it could be stopped. A period of drought, or excessive rain, might also have to be faced. But those were Nature's troubles, and were met with set face and stiff upper lip, for there was no getting over them, and they must be reckoned with when the annual accounts were made up. That valley of the Brahmapootra stood now a monument to the enterprise, pluck, and endurance of those early pioneers of tea, for they laid the foundation of a huge industry. And now they would assume that difficulties had been overcome, the leaf was plucked and manufactured, the tea had been sorted, packed, and despatched for sale, and how was it received in this country? Bear in mind that it is grown on British soil by our own fellow subjects, and it goes into every house and cottage in the United Kingdom. One would imagine that it should receive every encouragement, both in its production and consumption, but instead it was subject to a tax on entering the mother country of about 100 per cent. of its value. He could not help feeling that the action of the Government in raising the duty was the cruellest blow which the industry had received for many a long day. Let them just examine it impartially for one minute, and analyse the bearing which it would have upon the province of Assam, He took it that the policy of perfection was the aim of every industry, and by that he meant the endeavour to produce an article of the highest quality and perfection possible. Now, he thought he might say that this had been the aim and object of the majority of tea growers in Assam for many years past, and he ventured to think that they had met with some success in their efforts; but to produce these high quality tea costs money, and the cost of production must of necessity be high. It was only reasonable, then, to expect a corresponding high range of prices from the consumers, and this in the past had been forthcoming from the buyers of the United Kingdom. The effect of a high duty on any article of consumption must be either to check consumption or to lower the price to the buyer so as to bring the article within the means of the consumer, notwithstanding the high duty imposed upon it. This argument was borne out by the fact, which he thought would be admitted by Mr. Stanton, that since the imposition of the war tax, when the duty was raised from 4d. to 6d. per lb., the demand for common teas, that was tea of low price, had steadily improved while the demand for the finer qualities had diminished, except at prices which left little or no margin of profit to the grower. Well, if that had been the case with a 6d. duty, what was likely to be the position with a duty raised to 8d. per lb.? He very much feared that the demand for fine quality must steadily diminish under this heavy impost, and that the growers of such teas would no longer be able to look to the tea drinkers of these isles to take their produce. Whether other countries could be found to take their produce remained to be seen, but he ventured to repeat that the industry had received a staggering blow, when by every right it should have been offered the right hand of fellowship.

Mr. ARTHUR BRYANS said that as the representative of the largest tea-importing house in London he wished to enter his protest against the additional tea duty. He would draw attention to two facts, first, the rather curious line of argument taken by the Chancellor of the Exchequer when he said that he would put a penny on the income tax, which everybody thought quite fair, and 2d. on tea, the one seeming to apply to the pockets of the rich, and the other to the pockets of the working-classes. But the Chancellor of the Exchequer omitted to remind his hearers that in the previous year his predecessor reduced the income tax by 4d., but left the tea tax unreduced, and that what he was now doing was out of all proportion the one to the other. Mr. Austen Chamberlain's remarks would lead one to believe that he was doing something fair to each party, whereas he was doubling the war tax on tea, and was only replacing one penny of a fourpenny income tax. The other point was the remarkable fact that coffee and cocoa were left exactly as they were. The tax on coffee was only 1½d. a pound, and on cocoa 1d. a pound, compared with 8d. on tea. As 74,000,000 lbs. of coffee and cocoa were annually consumed in this country, surely it was fair that those beverages which came into competition with tea should bear a proportionate increase of taxation. The labour question presented great difficulties to all growers of tea, more particularly those in India. It was an anxious question, was always with them, and at the present time was bearing very hardly on the industry. A leader in the *Times* of the previous Tuesday gave a good idea of how labour was distributed throughout India; there were vast districts with teeming millions of population, and other parts with hardly any supply of labour at all. Assam was one of the latter countries. The industry had been beset by laws and regulations to protect the labourer, and, no doubt, equally to protect the planter, but their administration had always been a source of difficulty to the Government officials. He wished especially to draw attention to the fact that in 1901 a new labour Act was introduced, which was working very badly for the tea industry. There was a feeling amongst the officials in the districts from which the coolies came that the Government of India wished restrictions put on emigration. Such restrictions had been imposed and were very severely felt, the industry at the present time being in a very parlous condition for want of labour. In many districts there were Government officials anxious to promote the welfare of the industry; in other districts the officials were young men without experience and knowledge of the importance of the question. Sometimes, unfortunately, officials seemed to think that no European could do right, and that it was the native alone whose word must be taken as truth. There were many old Indians in the room who would agree with him that the native was rather like a child and had to be treated as such; how otherwise could a single planter look after 500 or 600 coolies? The majority of planters were very huma and considerate of their workpeople's wants requirements. In that connection there was question of vital importance, namely, the Gove ment liquor shops. Outside the very borders of tea estates there were liquor shops, which mad large revenue for the Government. Those liq shops ought to be very carefully looked after; it a matter of great importance that the coolies sho be kept sober instead of allowing them to have drunk orgies which often led to riots and even murde and which would not occur but for the desire of t Government to raise a revenue out of the sale of liquors. Mr. Bryans alluded to recent remarks Sir A. C. C. De Renzy, K.C.B., on this importa subject.

Mr. C. W. WALLACE wished to say how much t whole of the tea trade of India was indebted Lord Curzon, and how grateful, not only the t trade but all the different commercial and industri enterprises of India, were to him when they hea that he had agreed to extend his period of office a spend another two years in the country. Two yea ago, when the Chancellor of the Exchequer put t extra tax on tea, Lord Curzon, in consideration the condition of the industry, postponed for two yea the increase in the wages of the labourers, so makin the tax fall *pro tanto* upon the natives of India, as we as upon the so-called capitalists. Later, it was Lor Curzon who gave the planters the great boon of th tea cess, which the author had explained, and b which they were able to push their teas in foreig markets. He remembered that in the old days the approached the Government for a similar tea cess and were sent from pillar to post, department to de partment, secretary to secretary, and finally warne off altogether without getting what they wanted Lord Curzon had not been in office two years befor the observant tea planter noticed that the old orde was changing, and that they had a man stron enough to originate new ideas and carry them out The tea cess was thus obtained, and he hoped i would pull them through, if anything could, now tha the duty had been increased. He thought planter and growers were to blame for not taking more trouble to bring before the notice of the public of this country that they would save money by drinking a better class of tea than they usually did. A few thousand pounds spent in advertising that fact would, he believed, be of greater benefit than a great many more thousands of pounds spent in endeavouring to induce the French, Italians, Russians, and Turks to drink tea. Taking the present price of tea, first of all the Government of England charged 8d. a pound for duty; it cost 2d. a pound for distribution, handling, and wastage of tea in England; 1½d. a pound for the cost of bringing the tea from the estates by rail and steamer to the sea-board of India, and then by ocean steamer from India to England. Allowing 6½d. for the wretched planter to feed himself and his coolies,

d to provide interest on his capital, it made a total 1s. 6d. a pound as the very minimum price at hich one could buy economical tea—not a tea such he would recommend anyone to drink.

The CHAIRMAN said the paper and discussion had en very interesting, and they might unanimously rive at the conclusion that the tea industry deserved ell of the British Empire. The history of tea was ost remarkable. The amount of employment it had ven was very large, and, in spite of the taxation ith which it had had to contend, it had practically hieved a monopoly inside the British Empire; and foreign countries it was rapidly increasing in emand, as they could learn from the figures given by e author. He agreed with Sir West Ridgeway, at the planters of India and Ceylon were ever ready respond to the call of duty, and in places outside e sphere of their ordinary action to array themselves d fight on behalf of the Empire, and the race to hich they belonged. It was, therefore, rather hard at a body of gentlemen who had so distinguished emselves should be the only industry, when the war as over, to have additional taxation imposed upon em. It was all the harder, inasmuch as they had lso to submit, as had been pointed out, during the war heavy taxation, which was understood at the moment be imposed for war purposes only. He did not blame he Chancellor of the Exchequer for trying to meet e expenditure of the year out of taxation; and, lthough the tea industry had been unfortunately the ndustry selected for the additional taxation, he hoped hat good generally might result. The plain English f it was that the country had been spending too much in recent years. The craze for expenditure eemed to pervade all ranks, and their capital expenditure had increased at a rate which filled him with alarm. He believed it to be dangerous to the national credit that the increase of expenditure should go on. If a heavy additional tax was put upon an article of general consumption its price rose; and although this might be inconvenient to the industry at the moment, it would open the eyes of the taxpayers to the necessity of pressing upon those who epresented them the need for effective economy. There was one passage in the paper about which he hought the author must be careful. He pointed out now, when taxation had been imposed on tea, the prices fell, and when taxation had been remitted the price rose. Of course, there were other influences and agencies far more potent than taxation in regulating prices, but he thought the author must be careful how he edited those words, otherwise some young ardent fiscal reformer would assume rom that one instance that if one wished to make a thing cheap the best thing to do was to tax it. The broad, plain principle to lay down was that if an appreciable tax was made on an article of general consumption that article would not in ensuing years be as cheap as it would have been if that tax had not been imposed. It was a simple principle to adhere to, and one which could be enforced by stating the rise and fall of the price of tea, and the taxation imposed on it. Complaint had been made of the temporarily depressing effect which the currency policy of India had on the industry. He had never believed that a fall in exchange and a depreciated currency was beneficial to the community in which it circulated. What did it do? It was quite true that a falling exchange, not a low exchange, did help certain export industries. It helped them in this way. As the currency became depreciated so the prices rose of articles which were paid for in native currency. There was always an interval between the rise in the price of articles and a corresponding rise in the wages of those who were working in the production of those articles, and, therefore, the exporter obtained the benefit of that interval. But in course of time prices so adjusted themselves, that the employer had ultimately to give to his labourers practically all that he had made by the rise in price of the article which he produced, and, therefore, it was not a low exchange but a falling exchange that benefited an export industry. The exchange must go on falling to give that continuous benefit. During the whole time the exchange was falling it must be recollected that all those who transmitted their capital to India did so with the knowledge that they could not get it back at the rate at which it was remitted, and the inevitable result therefore was to induce people to over-speculate and over-produce in consequence of the temporary fall in exchange. They were compelled, for reasons which Sir West Ridgeway accurately defined, to have recourse to a policy by which that fall in the price of the rupee was stopped. Unfortunately, it hit the tea planter hard, because there was a rise in the exchange just at the moment when the great development of cultivation, owing to the fall in exchange, was beginning to have effect. He believed that for the future a stability of exchange would be beneficial to the tea industry, for he was perfectly confident that it was essential for successful business enterprise that the foundation of the calculations, *i.e.*, the monetary system, should be so stable as to enable them to make their calculations upon it with tolerable confidence. Therefore, although they were unfortunately compelled, in pursuing a necessary currency policy, to inflict some temporary hardship on the tea trade, he believed in years to come they would recognise that the Currency Act had been beneficial to the industry. Allusion was made to the difficulties connected with obtaining labour. He fully recognised those difficulties, and could endorse all that had been said in regard to the action of Lord Curzon. Lord Curzon, as he knew from private correspondence, had taken the greatest interest in the tea industry; he was most anxious to hold the balance fairly between the employer and the employed in the tea gardens, and by his influence he had succeeded in passing an Act which was just to both classes. But one difficulty had not been mentioned which was associated with the labour question. Nearly all, if not all, the coolies

who went to Assam, were obtained from one part of India, the Central Provinces, and they almost all belonged to the aboriginal tribes, whose habits had not varied for thousands of years; and, unfortunately, those tribes were not, like the majority of the people of the country, teetotalers, but very partial to drink. He quite agreed that the control of the liquor shops was a pressing question in Assam, and the difficulties arising from the coolies getting drunk were largely due to the fact that they were drawn from the class of people who had a partiality for drink. Whether or not it would be possible, under the improved conditions which recent legislation has enforced, to obtain a supply of labour from other parts of India he did not know; but if it were possible for the planters to draw from those who lived in a higher state of civilisation, who were more orderly in habits, and less addicted to drink, he thought it would be beneficial to the cultivation of tea. Then there was another small Act to which he readily gave his assent when he was Secretary of State, authorising the levy of a cess upon the export of tea, so as to enable the tea associations to exploit their business, and to work in unison. The great advantage of the cess was that it not only placed funds at the disposal of the tea planters for the purpose of pushing their business in different parts of the world, but it also necessarily brought them into association and enabled them to act together. He was very glad to know of the remarkable increase in the consumption of tea that had occurred during the last few years in foreign countries. He could not but believe that one of the results of the lamentable conflict between Japan and Russia would be to considerably extend the exports of Indian tea to foreign countries, because it was impossible to assume that if the war continued for any length of time Japan would be able to export as much as she had done in past years. One piece of advice which Lord Curzon gave to the tea planters seemed to him (the Chairman) full of value. Lord Curzon urged them to make special exertions to try and promote the use of tea in India itself. He (the Chairman) had never been in India, but he had taken very great interest in the tea industry. As there was a population of 300,000,000, mostly teetotalers and with a partiality for tea, he thought there was a great field for the development of the consumption of tea in India. He quite admitted that large masses of the population could not afford to pay for other than cheap teas; but still he believed that if native influence in behalf of tea was exercised, a steady and continuous development of the demand would occur, and eventually attain very large dimensions. He entirely agreed with the author, that pressure should be put upon the Custom House to pay more attention to the quality and wholesomeness of the very cheap teas which were brought into this country. He had rather an amusing experience with such tea some years ago. An importer wrote to him to say that the Customs had seized the tea which he had imported, as it was unfit for human consumption. He had a visit from the importer and said to him, "If it is unfit for human consumption why do you complain?" The reply was, "Oh, I am going to export it abroad. Abroad that class of tea is used as a medicine, and therefore, I consider it quite legitimate to get it out of bond and take it abroad." He did not agree with the validity of this argument, but he found that the importer was quite right, because shortly afterwards when travelling on the Continent with a friend, the latter was taken ill and was attended by a German doctor, who prescribed for him, amongst other things, tea, which had the effect which the gentleman who wished to export the tea anticipated. It, therefore, appeared to him that they would be justified in putting pressure on the Chancellor of the Exchequer to get the Custom House to subject this article to a more rigid examination. Tea was food; it was nutritious, a solace, a restorative, and a stimulant to all races and to all ages between the nursery and the grave; and as such, he thought they could not better discharge a duty in connection with promoting Imperial industries than by giving their interest and sympathy to tea and all connected with it. In conclusion, he proposed a hearty vote of thanks to the author for his able paper.

The vote of thanks was carried unanimously.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, JUNE 6...Engineers, in the Theatre of the United Service Institution, Whitehall, S.W., 7½ p.m. Mr. Percy G. Scott, "Notes on Railway Surveys and Design in New Countries."

Chemical Industry (London Section), Burlington-house, W., 8 p.m. 1. Mr. J. H. K. Inglis, "The Loss of Nitre in the Chamber Process." 2. Mr. A. Marshall, "Acetone—its Manufacture and Purification." 3. Dr. J. Gordon Parker and Mr. E. E. M. Payne, "A New Method for the Estimation of Tannin."

East India Association, Westminster Palace Hotel, 4 p.m. Mr. F. H. Skrine, "Benares Mutiny of 1799."

TUESDAY, JUNE 7...Zoological, 3, Hanover-square, W., 8½ p.m. 1. Lt.-Col. J. Malcolm Fawcett, "Some new or little-known Butterflies." 2. Dr. A. G. Butler, "Seasonal Phases in Butterflies." 3. Mr. F. E. Beddard "Note on an apparently Abnormal Position of the 'Brephos' within the body of a Skink." 4. Dr. E. A. Goeldi, "The rare Rodent *Dinomys branickii* Peters." 5. Mr. C. Satunin, "The Black Wild Cat of Transcaucasia." 6. Mr. R. Lydekker, "A Buffalo Skull from East Central Africa." 7. Dr. A. Smith Woodward, "Two New Labyrinthodont Skulls."

Colonial Inst., Whitehall Rooms, Whitehall-place, S.W., 8 p.m. Mr. W. W. A. Fitzgerald, "The Commercial Possibilities of the Soudan."

WEDNESDAY, JUNE 8...Victoria Institute (at the HOUSE OF THE SOCIETY OF ARTS), John-street, Adelphi, W.C., 4½ p.m. Annual Address by the Lord Chancellor.

Japan Society, 20, Hanover-square, W., 8½ p.m.

United Service Inst., Whitehall, S.W., 3½ p.m, Mr. A. H. Burgoyne, "The Future of the Submarine."

Dante Society, 22, Albemarle-street, W., 8½ p.m. Mr. L. Ricci, "Boccaccio."

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FRIDAY, JUNE 10, 1904.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

ADDITIONAL MEETING.

An additional meeting of the Society will be held on Wednesday, June 22nd, at 5 o'clock, when a lecture, in connection with the London meeting of the "International Olympic Games Committee," on "The Northern Games in Stockholm and Sweden and its People" will be given by Colonel Viktor Balck, President of the Northern Games Committee. The Right Hon. the Lord Chief Justice, G.C.M.G., will preside.

Members besides having the right of admission, can admit one visitor to the meeting by the use of the usual tickets.

EXAMINATIONS.

The following is the Time Table for 1905. It is for the present subject to alterations :—

Monday, April 10 (7 to 10 p.m.).

Advanced Stage :—Accountancy and Banking, Portuguese, Précis-writing, Russian, Chinese, Japanese, Hindustani.

Intermediate Stage :—Arithmetic, German, Portuguese, Italian, Russian, Chinese, Japanese, Hindustani.

Elementary Stage :— German, Typewriting (from 7.30 to 10 p.m.).

Tuesday, April 11 (7 to 10 p.m.).

Advanced Stage :—Commercial Law, Arithmetic, German, Italian, Spanish.

Intermediate Stage :—Book-keeping, Précis-writing.

Elementary Stage : — Handwriting and Correspondence, French, Italian.

Music :—Harmony.

Wednesday, April 12 (7 to 10 p.m.).

Advanced Stage :— French, Commercial History and Geography, Typewriting (from 7.30 to 10 p.m.).

Intermediate Stage :—English, Economics, Spanish.

Elementary Stage :—Book-keeping, Spanish.

Music :—Rudiments of Music (7 to 9 p.m.).

Thursday, April 13 (7 to 10 p.m.).

Advanced Stage :—Book-keeping, English, Economics, Danish.

Intermediate Stage :—Typewriting (from 7.30 to 10 p.m.), French, Danish, Commercial History and Geography.

Elementary Stage : — Commercial Geography, Arithmetic.

Friday, April 14 (7.15 to 10 p.m.).

Advanced Stage :—Shorthand (from 7.15 to 10 p.m.)

Intermediate Stage :—Shorthand (from 7.15 to 10 p.m.).

Elementary Stage :— Shorthand (from 7.15 to 10 p.m.).

The last day for receiving entries is March 10.

The special subject for Commercial History and Geography is :—Central Europe, comprising Italy, Switzerland, Germany, the Alpine provinces of Austria, and Alpine departments of France with the Rhone Valley, Holland and Belgium.

CONVERSAZIONE.

The Society's Conversazione will take place at the Royal Botanic Gardens, Regent's-park, on Monday evening, June 27th, from 9 to 12 p.m.

The programme of arrangements will be announced later.

Each member is entitled to a card for himself (which will not be transferable), and a card for a lady. These cards will be forwarded in due course. No application for them is required. In addition to this, a limited number of tickets will be sold to members of the Society, or to persons introduced by a member, at the price of 5s. each, if purchased before the date of the Conversazione. On that day the price will be raised to 7s. 6d.

Members can purchase these additional tickets by personal application, or by letter addressed to the Secretary. In all cases of application by letter a remittance must be enclosed. Each ticket will admit one person, either lady or gentleman.

Tickets will also be supplied to non-members on presentation of a letter of introduction from a member.

Light refreshments (tea, coffee, ices, claret cup, &c.) will be supplied.

Proceedings of the Society.

APPLIED ART SECTION.

Tuesduy evening, May 17, 1904; SIR GEORGE BIRDWOOD, K.C.I.E., C.S.I., in the chair.

The paper read was—

PEWTER AND THE REVIVAL OF ITS USE.

By ARTHUR LASENBY LIBERTY.

In this room, ten years ago, a paper on pewter was read by Mr. Starkie Gardner, which remains one of the most valuable treatises which have been written upon this interesting subject. And nothing, perhaps, could better aid the purpose which we have before us to-day than to recall Mr. Gardner's opinion of the state and prospects of the pewterers' craft. In the opening paragraph of his paper he writes:—"We should scarcely expect to find in these days of art revivals and competitions any field practically unoccupied. Yet though the venerable craft of the pewterer can hardly be called extinct, it is, from an art point of view, distinctly moribund; and this neglect is the more remarkable because there is no sort of reason that it should be so." I take, therefore, this statement as to the condition of the craft only ten years ago as my excuse for adding to the number of those who have recently followed Mr. Gardner's lead and discoursed on pewter. And, in so doing, I desire to explain that when, on the suggestion of our distinguished Chairman, Sir George Birdwood, I undertook to prepare the present paper, I did not know (and our Chairman did not know) that it was proposed the meantime to hold an exhibition pewter at Clifford's Inn Hall, and that the would be a series of lectures given c pewter, nor did I know of the projecte publication of Mr. Massé's erudite wo which has since appeared on the same sul ject. I purpose, therefore, going over on so much of the ground which has no been so fully covered by others as may co veniently lead up to a subject which, believe, has not been touched upon—namely that since 1894, an attempt has been mad to revive the ancient industry which, s critical an observer as Mr. Starkie Gardne declared to have all but disappeared.

EARLY RECORDS OF PEWTER.

Taking first a wide survey of the whol subject, it will be remembered that the advan tages of using an alloy in the working o metals appear to have been known and ap preciated at a most remote period in th history of the human race; and that not only does such process combine the different ex cellencies of the two or more metals used, bu the cohesion and consequent strength of the alloy is generally found greater than either of the metals considered separately; instead of, as might be supposed, resulting in the exact mean strength of the two or more metals employed. It is considered most probable, too, I believe, that the first discovery of metals was due to the accidental presence of ore in the stones used in primitive hearths and fire-places, and that, consequently, the more readily fusible metals such as copper, tin, and lead, were those first known; and of these, copper being the most widely diffused, is supposed to be the first metal used by man. Copper is, however, rather difficult to cast, and it must have been one of the most notable discoveries made by our primeval forefathers, that by a small admixture of tin an alloy was produced that could be easily cast, was capable of being finished to a smooth surface with sandstone or a file, and was very much harder than the original copper itself. Weapons and instruments made of this alloy, that is to say of bronze, are, therefore, as is well known, characteristic of the early stages of civilisation—the termination of the stone age showing occasional evidence of the use of pure copper. In later, as well as probably in prehistoric times, large quantities of the red metal copper were obtained from Cyprus (whence is probably due its modern name). While as far back

s nearly 4,000 B.C., according to Mr. 'linders Petrie, the Egyptians are said to iave worked copper mines in the peninsula ,f Sinai for the production of bronze. But he question, I believe, is still an open one is to where the ancients derived their supplies)f tin. Tin, however, is mentioned among the poils taken from the Midianites, and it has)een conjectured that it was mined in some listrict of Central Asia because it is also laimed to have been known (though where obtained is not clear) at an equally early date in China; and I believe, also, in Hindustan.

At a later date, but still before the Phœnicians had sailed beyond the pillars of Hercules, tin was unquestionably shipped from Tartessus in the South of Spain, a locality generally identified as the Tarshish of the book of Ezekiel. Still later, as we all know, the same enterprising navigators traded for tin to Cornwall and Devon, the Cornish peninsula, indeed, being identified by the Greeks solely with that metal, and named by them "Cassiterides," the land of tin, a title which, in view of the continuance and richness in the supply of this metal, it might justifiably have retained to days within living memory. Bronze being therefore the earliest known alloy, it may, perhaps, be permissible to suppose that the invention of pewter was due to an accidental reversal of the bronze-making process. That is to say, a small quantity of copper being mixed with a large proportion of tin. Be this as it may, such an alloy was subsequently discovered and found to possess much greater toughness and malleability than the pure white metal, and proved not to be affected by the acid of wine or vinegar (as was bronze). It was, too, both in appearance and durability, to a certain extent, a passable substitute for the rarer metal silver. It has even been suggested as probable that the "tin" mentioned by Homer in his description of the shield of Achilles; the "tin" statue of Dædalus referred to by Aristotle, and other similar artistic works described by ancient writers, was in reality a kind of pewter, since pure tin is very brittle, especially at certain temperatures, and not at all adaptable for working easily with the hammer.

Plautus mentions pewter dishes as being used at a banquet, and Galen recommends the keeping of antidotes and other drugs in vessels of glass, silver or pewter. It would exceed the bounds of this paper, however, to attempt to follow the not too easily traceable history of pewter through the classic to the middle ages; although I wish to call passing attention to some illustrations of pewter vessels from the extremely interesting collection of Romano-British pewter now in the British Museum. It will suffice to mention that the craft existed in the early days of Greece and Rome, was never absolutely lost, even in the dark ages, and was practised, more or less, in Saxon and Norman times in England as well as on the Continent. In mediæval days the principal patrons were, of course, the Church, especially the monasteries. But I believe no specimens of this period are now extant. And this recalls the unfortunate fact that the facility with which pewter can be re-melted and cast has been always fatal to the survival of ancient examples. For, whenever pewter objects became badly worn or bruised, it was always customary to send them to the melting pot to be remoulded. All the ancient pewter utensils and vessels which have come down to us, are, therefore, those only which could not readily receive damage.

As Viollet-le-Duc points out, pewter in mediæval days was the material in universal use for the tables and sideboards of the middle and upper classes. Silver plate appearing only in the Royal palaces and in the dwellings of the highest nobles, and then probably in very limited quantities at the upper table on the dais. The peasant and the artizan, it will be remembered, used dishes and platters of wood, or, as it was called, "treen," from whence we are told comes our word "trencher."

The Pewterers' Craft in England.

The manufacture of pewter, therefore, during long centuries was a most important industry, the quantity produced was enormous, and from the 8th century, when the mines of Spain, the only others which appear to have been of importance, had ceased to be available in consequence of the Moorish conquest, down to the discovery and working of the tin mines at Perak, our own country possessed a practical monopoly of the metal, for the tin derived from Bohemian mines discovered in the 13th century was comparatively small in quantity. I would suggest, therefore, that the major portion of the pewter made in Europe from the days of Roman civilisation down to the latter part of the last century, was made from English tin. That is to say, down to the time when the general use of pewter was supplanted by the introduction of earthenware and glass;

just as in the same way pewter itself had previously supplanted the general use of wood ware. Assuming then the patriotic postulate that Great Britain so long held a practical monopoly in the supply of tin to the world's markets to be correct, I purpose referring in detail to the tin and pewter industries mainly, in this country only, and the more particularly as they seem to be sufficiently typical of the like industries elsewhere.

Mr. Welch tells us that by far the larger portion of the tin produced in England was absorbed between the Pewterers' Company of London and members of the same craft throughout the country. Bapst says that Bruges was the principal mart for British tin on the Continent, and that it was supplied thence to the whole of the North and West of Europe. The tin mines are still called Stannaries (from *Stannum*, the Latin word for tin), and were at a very early period granted privileges and placed under regulations by the Crown. According to Camden, King John, who was Earl of Cornwall before his accession to the throne, gave the Earldom with its privileges to his second son Richard, who derived from the stannaries in royalty and fines an annual income of 200 marks, equal to about £20,000 of our money. Great revenues, says the foregoing authority, were drawn from the same source by the Dukes of Cornwall (beginning with the Black Prince; the royalty in the Middle Ages being as much as 40s. (equal to over £30 of our money), for every thousand pounds weight of dressed tin brought into the market. All tin had to be brought to certain specified towns to pass the Stannary Courts, and there be stamped with the mark of the Duchy and the dues paid. After which, according to Mr. Welch, the Guilds of the Mines could sell to whom they pleased, except that the King or the Duke had the right of pre-emption at the market price. Later, the Pewterers' Company of London obtained the right to purchase one-fourth of all the tin brought to London for sale. The tin miners and, in fact, all connected with the industry at the mines were subject only to their own Stannary Courts of Law (except in capital cases), and had even their own prison at their headquarters at Lostwithiel. Generally speaking the royalties and dues were farmed. It must be understood, too, that whereas in other parts of the United Kingdom only the gold and silver was reserved to the Crown, the tin of Cornwall and Devon has always been the property of the King whoever may have been the owner of the soil. It is a peculiar institution, therefore, of Cornwall and Devon that, on lands not under cultivation, anyone on complying with the necessary formalities can mine for tin on condition of paying the royal dues, and one-fifteenth to the landowner. The last assembly of the Stannaries was held in 1752.

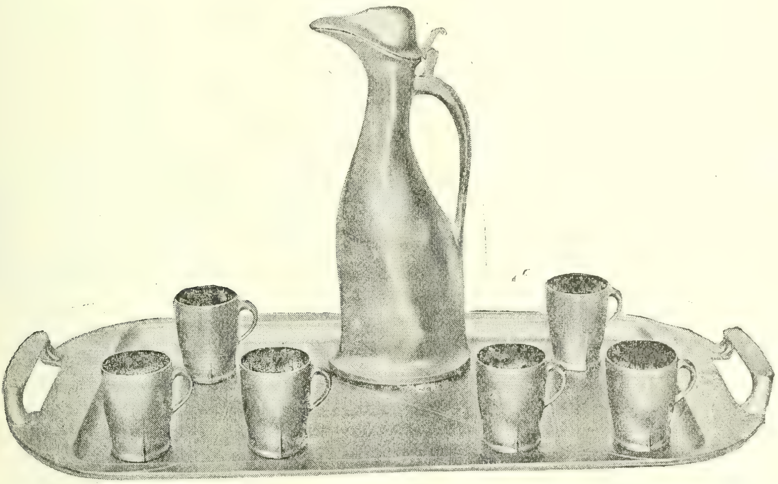
In common with all the other crafts carried on in the towns, that of the pewterer was doubtless bound by some sort of fraternity or association in the early Middle Ages, but the first formal institution of a Guild was in the reign of Edward III. A.D. 1348. The ordinances for the government of this body, were drawn up by its members and submitted to the Lord Mayor and Aldermen, and by them approved. The records of the Craft of Pewterers thus commenced, are more or less continuous from the establishment of the still existing Pewterers' Company in the reign of Edward IV., A.D. 1473, and are the material from which Mr. Welch has compiled his interesting history of the Pewterers' Company published two years ago. These records, too, are not only interesting as a history of the Guild, but afford a mass of information as to its relations to the general body of the citizens, and the Government of London in mediæval times. The earliest rules for controlling the craft provide for the assay of all wares and for experts superintending the same. Anyone selling pewter before it passed the proper test, was condemned to forfeit the goods. Still, contrary to the general belief as to custom in such matters, the regulations do not appear to limit the ranks of the workmen to those who duly passed through a formal apprenticeship, but stipulated that either such (or otherwise competent men) should be employed. An incidental commentary on the primitive lighting arrangements of the time is contained in the rule that no work is to be done at night, and it is easy to understand that work produced under the flare of a rough flambeau, or, on the other hand, by the meagre light of a tallow candle, was not likely to enhance the reputation of the craft. As just mentioned, the penalties for bad workmanship, or for inferior quality of metal, were forfeiture of the articles and fines; suspension from membership was also inflicted in some cases, and for very bad or often-repeated offences, expulsion. This last practically amounted almost to outlawry, for unless the offending member were readmitted, it deprived him of his livelihood; since, if not a member, he could neither buy nor sell, nor be employed.

[N]o master was to employ a workman without character from the last employer, nor was he, [u]nder any circumstances, to entice away [a]nother's workman.

The qualities of pewter were also prescribed [t]o prevent adulteration and inferior quality [o]f metal being used. These regulations were [a]lways strictly enforced, and the control of the [G]uild over the trade was fostered by the Crown [a]nd Parliament for many ages, its effect being [t]o set up a very high standard of quality, [b]oth of material and workmanship, and thus [m]aintain the excellent reputation of English [p]ewter, besides insisting on a code of com[m]ercial morality which could not but have a [g]reat effect on the members as citizens.

regulations in question, having now been ratified by the lawful government of the city, first put the control of the trade on a legitimate basis. It must also be remarked that such control, though absolute, was not despotic, an appeal always lying to the Lord Mayor and Aldermen in cases of injustice and oppression. In fact, not only under the Craft of Pewterers, but afterwards under the duly chartered Pewterers' Company, the City Fathers often interfered in case of an arbitrary exercise of power, without any appeal to them having been lodged. With all the faults of the paternal government of trade during the Middle Ages the spirit of the Guilds was distinctly democratic, and such regulations were recognised

FIG. 1.



LIQUEUR SET AND TRAY, WITH FLORAL ORNAMENT IN LOW RELIEF. (*Modern German.*)

as existing for the benefit of all. The records show, indeed, in a very striking manner the absence of privilege and mere influence, the very master or wardens of the company, in their capacity of craftsmen and dealers, sometimes falling under its discipline.

The craft at this time consisted of three grades, the Livery or Brethren, from whom were elected the Wardens and other officers of the craft, the Freemen or Yeomanry, members who had obtained license to set up in business for themselves, and the Covenant men (journeymen) and apprentices. One of the rules most strictly enforced was that no members were allowed to go to law with one another, all disputes having to be submitted for decision to the Warden and craft, thus keeping in view the idea of brotherhood in the society.

These ordinances, it must be remembered, were promulgated by the body called the Craft of Pewterers; and although there was doubtless a fraternity of workmen prior to this, and probably dating from quite early times, the

During the hundred and thirty years which elapsed between the formation of the old body of the Craft of Pewterers and the incorporation of the Pewterers' Company the Guild had no Hall, but rented premises for their feasts and business meetings from the House of the Austin Friars. Special religious services were observed by the brethren at Christmas, Easter, and the Feast of the Assumption, generally at the Church of the Grey Friars. The expansion of trade and the consequent increase of wealth and influence of

the City of London generally during the 15th century, doubtless excited the ambition of the craft for incorporation as a regular City company, and after delays, probably due to the disturbed state of the Government through the

FIG. 2.

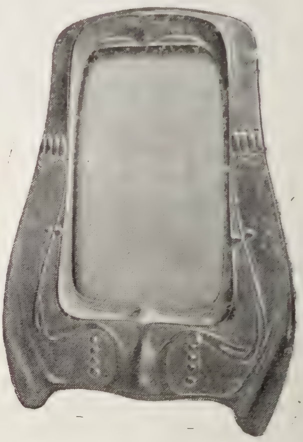
BISCUIT BOX, WITH INDENTATIONS ON TOP OF HANDLES FOR GRIPPING. (*Modern German.*)

Wars of the Roses, a charter was granted by King Edward IV. in 1473 creating the existing Pewterers' Company. This charter is still preserved in the archives of the Guild, and is a beautifully written and illuminated document in Latin. The powers already *de facto* possessed by the craft, were by this instrument confirmed and extended, one of the most valuable new concessions being that of the right of search for inferior goods and metal below the proper standard of purity. This right not only was to extend over London and its suburbs, but over the whole country, and all provincial mayors and sheriffs were enjoined to assist the company's officers in the work. All such inferior goods or metal was to be seized and sold; the proceeds to be divided between the company and the Crown. These searches besides fulfilling the primary object of protecting the trade against fraud and bad work, had the result of greatly strengthening the company's importance, and consequently attracting numbers of provincial pewterers into its ranks. The officers of the company who undertook the country searches were accustomed to entertain the provincial master pewterers while on circuit at the expense of the Guild, and the country members when in town also enjoyed the hospitality of the City. Hawking goods by pedlars at fairs or markets was strictly forbidden, under pain of fines and confiscation of the articles, the shopkeepers who, of course, were at the charge of rent, taxes, and other dues, claiming and enforcing the privilege of keeping the trade in their own hands.

Soon after the establishment of the company and its consequent expansion, the need began to be felt for a Hall of its own, and accordingly a site was found for the same in Lime-street, where the present Hall now stands. From very early times it had been the custom for the wardens to purchase large quantities of tin from the stannaries in bulk, and to retail the same at a small profit to the members, a plan doubtless advantageous to all parties, as the profit was applied to the payment of the general expenses of the Guild. During the building of the Hall, however, which necessarily caused a great drain on their resources, this practice was discontinued, but was resumed on the completion of the work. Part of the site was occupied by tenements built at the same time by the company, and the rents of these, and sums received for the hire of the Hall for wedding parties, appear to have materially increased its income.

In 1504 a statute of the Parliament of King Henry VII. abrogated the right of any guild or company, to make ordinances without the same having received the assent of the chancellor, treasurer, or other officers of the

FIG. 3.



FRAME FOR HOLDING PHOTOGRAPHS. (*Modern German.*)

realm, and at the same time rendered illegal the particular bye-law which forbade members of such a fraternity from suing one another in the King's courts. In the same Parliament an Act was passed in the interest of the pewterers to suppress hawking by pedlars, the

dulteration of metal and the use of false cales and weights. This statute was conirmed in the fourth year of the reign of Henry VIII.

In accordance with the first-named Act of 1504, the ordinances of the company were, after 18 years' delay, submitted to the King for confirmation in 1522, and duly assented to after the usual presents and gratifications to courtiers and ministers. About this time the importation of foreign pewter was seriously competing with the English trade, and after a considerable amount of lobbying and bribery in Parliament, an Act was passed in 1533, totally prohibiting the importation of foreign pewter, any so smuggled to be forfeited, together with a fine to the amount of the value. The right of search was again confirmed, and no foreigner

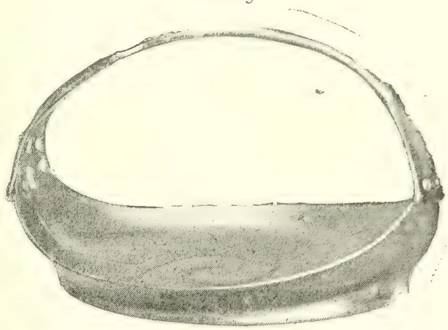
Fig. 4.

Coffee Pot, spout made in one piece with the body. (*Modern German.*)

was to be employed in the trade under any circumstances and under heavy penalties, and no person of foreign birth to be apprenticed. It was also forbidden for an Englishman to exercise the craft anywhere beyond sea, and thereby teach it to foreigners. Hawking was again forbidden, even when exercised by duly qualified pewterers, none to be sold except in a shop attached to a dwelling house, or in open fairs and markets. It is curious to note here that the Pewterers' Company republished these Acts in a book form so late as 1741.

As an instance of the tight hold kept by the company on its members, it may be mentioned that at a court held in March 1559, it was decreed that Robert West should bring his wife upon Friday next to "reconcile herself to Mr. Cacher and others of the company, for her naughty misdemeanour of her tonge towards them."

Fig. 5.

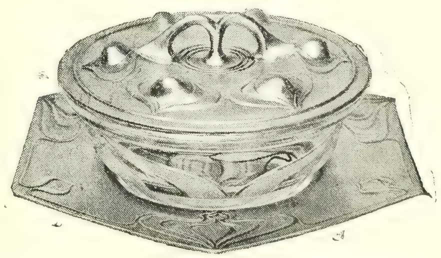


Cake or Fruit Basket, with aquatic ornament in low relief. (*Modern German.*)

No man was allowed to set up in business without first submitting to the master and wardens a specimen of his work. In case of disputes between members of the Guild, it was often decided that the one of the litigants held to be in the wrong should invite the other with his wife to supper, "and then to be merry together and so to be lovers and friends henceforth."

A very high standard of commercial morality was enforced; for instance, no pewterer was

Fig. 6.



Tray and Lid for Gl ss Butter Bowl. (*Modern German.*)

allowed under a penalty of a fine of 20s. (probably equal to £10 of our money) to say to a prospective customer that his goods were superior in quality to those of others.

The following is a specimen of the amenities obtaining at the time between the English and those of the sister kingdom :—" Thomas Wolshire shall pay for his opprobrious words towards Richard Scot, saying he played the

Scot's part and had the Scot's heart—16 pence." Members had to attend the funerals of their *confrères* on pain of fine, unless they had a reasonable excuse.

Not only apprentices, but unmarried journeymen lived in their master's house, and accompanied him to church on Sundays. They were not to absent themselves until after the afternoon service, when they were permitted to amuse themselves with shooting at the butts and dancing. On the other hand, the company was resolute to defend the rights of members, and once, for example, forbad any of the craft from serving any persons belonging to the Saddlers' Company, until a claim against it by a pewterer had been satisfied. Adulteration of metal, as before mentioned, was severely punished, sometimes by expulson, the culprit being described as acting contrary to his oath, and, "like no trewe pewterer and to the great slaundre of all the pewterers in London." Sometimes on giving an undertaking and a surety not to repeat the offence, he was received back, but was made to pay a substantial fine. In cases when the offence was not very flagrant, the punishment was to make the culprit change his mark, this being equivalent to a fine, in consequence of the loss of time, and the expense of re-marking his stock and obliterating his old mark.

The statute of apprentices having been passed in 1563, the company, in 1564, issued an ordinance that each member of the Livery should be allowed to take one apprentice, the master and wardens might have three, but only on condition that they employed two journeymen. Misbehaving apprentices were sometimes sentenced to be whipped in the Hall. No member was allowed to sell old pewter bought secondhand, and no pewterer was to act as scullion even for the Lord Mayor himself, nor to repair or clean pewter except at his own workshop. A suggestive rule for maintaining the dignity of the craft. Gilding pewter was strictly forbidden, except when given as a present to friends. To ensure proper registration, the members of the Livery were accustomed to set up their marks in the Hall.

It was a custom co-existent with the company for members to be enrolled who were not pewterers. An instance that may be given is that of one Isaac Tucker who, in the year 1556, was admitted on the recommendation of "Sir Water Rawghley" (*sic*) on payment of £10, half the usual fee payable by such members. It is expressly stated that this was done out of respect to "Sir Water," and for no other reason.

No journeyman was allowed to trade on his own account, but must obtain the permit of the company, and register his mark, or "touch" as it was technically called, and if a tradesman left London, and afterwards returned, he had to pay his dues for permission to start a second time. No tin was to be exported, except after having passed through the pewterer's hands, that is, in bars, or made into pewter ingots.

In the last year of Elizabeth's reign, it was forbidden to allow country pewterers and others to enter shops where London men were at work. "Whereby they come to great light of further knowledge." In other words, were finding out trade secrets. The monopolies granted by James I. to the farmers of tin had a very prejudicial effect on the industry, and the company accordingly petitioned several times against the practice, which, after a time, was modified by the King. The 16th and early part of the 17th century must have been the palmy days of the pewter trade. The prosperity of the middle class brought substantial comfort into the homes of the artizan and the labourer, and every fairly well-to-do citizen, among other belongings, seems to have made a point of possessing his "garnish" of pewter, while even the thrifty workman and peasant had a modest quantity. A "garnish," I may here recall, consisted of 12 plates, 12 smaller platters, and 12 dishes. At this period, also, large quantities of pewter were kept in stock by members of the trade, for hire to the nobility and gentry as well as to public bodies for banquets and other festivities, the pewterers often helping one another with loans, when a great demand was made on their resources.

Decline of the Industry.

The causes of the decline of the pewter manufacture in England as on the Continent were mainly, as before stated, the competition of cheap earthenware for table and other domestic use, followed by deterioration of quality and design, and consequent loss of influence on the part of the English Pewterers' Company. The Guild had, for centuries, maintained by rigid enactments, the high quality of English pewter, both for home consumption and for export, and these enactments were enormously aided in their enforcements by the company's right of search. During the troubles of the great Civil War, however, this right fell almost into desuetude; and after the Restoration, the company found

that it is much easier to maintain a privilege than to re-impose one when once practically abrogated. The right of search was felt to be unsuited to the spirit of even that age, and the company never succeeded in getting it legally recognised again. Possibly, as has been suggested, the authorities were indisposed to bring the question before the courts of law; as in the case of an adverse decision, the right would definitely cease to exist,

FIG. 7.

CANDLESTICK, WITH HOLLOW COLUMN ADAPTABLE FOR ELECTRIC LIGHT. (*Modern German.*)

whereas, by leaving the matter unsettled, it might be once more established, should a favourable opportunity arise. It is probable also, that the practice which we have seen had existed from early times, of admitting into the fellowship of the Guild members who were not connected with the craft, became more and more common, until many of the influential so-called "pewterers" had ceased to possess any real business interest in the trade, with the inevitable result that the main object of the existence of the company was neglected.

Efforts, however, were made, from time to time, to revive the declining industry, but slowly and surely the products of the potteries ousted the plates, dishes, and vessels of pewter, whilst the art of plating inferior metals with silver displaced the old pewter dish covers, cruets, salt cellars, drinking cups, and the like, until at last even in the village inns and hostelries the electro-plated tankards displaced the pewter pot. This last fact is significant, since good judges of malt liquor never lost the tradition that ale or stout was of better flavour when drunk from what was called "its native pewter." Thus the once flourishing craft of the pewterer degenerated to the production of some few mere utilities, such as lavatory fittings, public house bar appliances, and plumbers' requisites. Although exclusive reference has been made to English pewter, we must not forget that the pewterers' craft embraced Scotland, notably Edinburgh, as demonstrated by the "Tappit Hen" and "Christening Tankard," which examples by the courtesy of Mr. Walter Churcher are, with others from his collection, here for our inspection this evening.

MARKS.

Great numbers of old touches or maker's marks, have come down to us, but it is, unfortunately, the fact that no register of them exists, and unless the name is mentioned they are therefore difficult to identify. Much interesting information from the collector's point of view has been written on the subject of marks, but it will suffice for the purpose of this paper to say that no piece of pewter was allowed to be sold without a mark, and that this rule extended to the pewter mountings on stone-jugs and tankards; and it is thought probable that the crowned "Rose" mark was, in some measure, the official "touch" of the Pewterers' Company, being one of their armorials, while the double "f" was a penal mark sometimes affixed to the work of a member who had been found guilty of malpractices, and signifying, as it did false, the result commonly was his being obliged to join the ranks of the journeymen of the craft.

ALLOYS.

And now I must refer to the alloys and the process of actual manufacture. It is still questionable, I believe, what were the precise alloys, and the relative proportions, used in the manufacture of ancient pewter; and, indeed, down to our own day the word pewter has an elastic meaning. I gather, however that some among the old examples show a

large admixture of lead, as for instance, a vase-handle of the 4th century of our era, dug up in Rome, which, according to Bapst, was assayed in France early in the last century and found to contain about three-sevenths lead

FIG. 8.

TWO-HANDLED VASE. (*Modern German.*)

without any trace of copper. This must, therefore, be considered as of very inferior quality. By way of explanation, it has been suggested, indeed, that tin procured with difficulty from a remote and barbarous region was almost as dear as silver, and that this may account for the low grade of pewter being in use in Rome. On the other hand, however, Mr. Gowland's analysis of varying examples of Roman pewter show that the question of cost was by no means invariably considered. His results give for what he terms "typical Roman pewter:—72·36 tin to 26·90 lead, and 70·58 tin to 27·62 lead, that is, to put it roughly, three parts tin and one part lead.

According to Mr. Welch, in the ordinances of the old English craft of pewterers, two qualities of pewter are described, the first of tin with a small admixture (supposed to be about 5 per cent.) of what is called "kettle brass," otherwise known as "peak" metal. The peak metal being a compound of copper with some other metal not definitely ascertained, and probably always kept a mystery of the Guild. The second quality was originally called "vessel of tin," being a compound of tin and lead, in the proportion of 1 cwt. of tin to not exceeding 26 lbs. of lead. This alloy was afterwards known as "lay" or lead metal.

Some old pieces of the Elizabethan and Stuart periods were assayed two years ago by my friend, Mr. Haseler, when conducting some experiments on behalf of Liberty and Co., and besides tin he found them to consist of small quantities of copper, with traces of antimony. The latter probably being added for the hardening and cleansing of the other metals. These pieces were of what is known as the old first quality of pewter. We have seen that the craft always guarded most jealously the good reputation which the English pewter held, and that it included the keeping up of the requisite standard of purity in the metal. It was, for this purpose indeed, that the Pewterers' Company possessed and exercised their peculiar powers. Thus, as has been noted, all tin brought to London was liable to be assayed by the company's inspector before being sold: and it could be seized and forfeited if of inferior quality, no matter to whom it might belong. It was also ordered

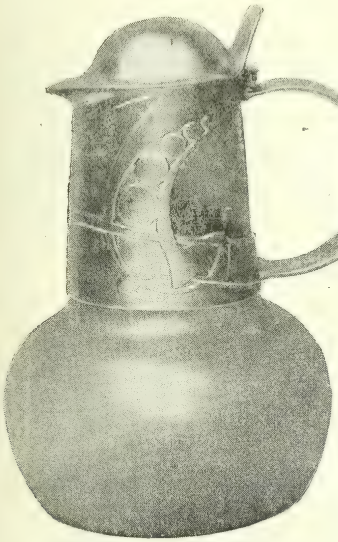
FIG. 9.

HOT WATER JUG, WITH ORNAMENT IN LOW RELIEF. (*Modern English.*)

(in 1438) that all articles (in accord with a published list) should be of a certain standard weight, thus ensuring to purchasers a definite quantity of the metal. This was, doubtless, an excellent rule to prevent fraud when re-casting was so constantly resorted to in order

o make good the constant wear and tear to which pewter articles were liable at a time when hey were used for, practically, all domestic purposes. Thus, it was a definite rule that "chargeours" of the largest size were to

FIG. 10.



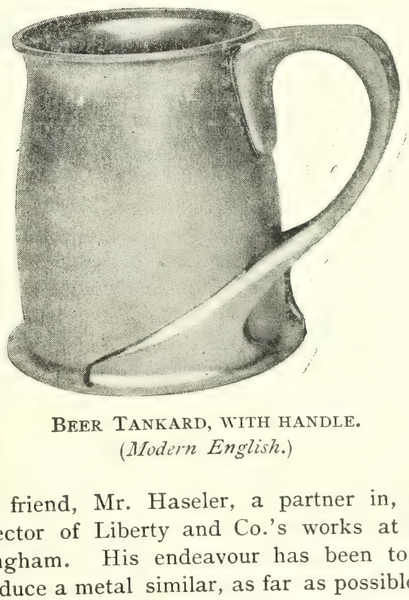
GLASS CLARET JUG, WITH METAL MOUNTINGS.
(*Modern English.*)

weigh $\frac{3}{4}$ cwt. per dozen, *i.e.*, 7 lbs. each, and small "bolles" 13 lbs. per dozen.

In the present day, and of late years, many experiments have been made and various modifications have been tried in the composition of pewter; nearly every manufacturer having his own particular formula. For the production of modern pewter goods aspiring to be classed as artistic in design, the inferior alloy containing lead is discarded altogether (except by the Japanese in the manufacture of their antimony ware). And to avoid as far as possible the use of copper, which some consider to have a bad effect on the colour, tin is nowadays alloyed in the proportion of about five per cent. of antimony, or bismuth, or both. An excess of copper imparts a brownish tint, whilst the use of lead (always be it remembered the alloy of the so-called second quality pewter) imparts the well-known grey colour tone which, be it acknowledged has for some of us a decided charm. Still, as we know, if lead is used beyond a certain proportion it renders the pewter dangerous for the use of liquors containing acids, such as beer, wine, vinegar, &c., by reason of the chemical action they set up, the excess lead producing poisonous oxides.

A series of experiments were made some years ago under the auspices of the French Government, which resulted in a law being passed prescribing the proportion of lead which may safely be used, and this was fixed, for France, at $16\frac{1}{2}$ per cent. The old pewterers appear to have had one advantage over the modern in the fact that their lead nearly always contained a small percentage of silver, which (unfortunately for the pewter trade) science has enabled the modern smelters to extract. That is to say, the fascinating lustre which many old pieces of pewter possess, is generally ascribed to the presence of this small proportion of silver in alloy. Modern German pewter, as compared with modern English, contains a much larger proportion of antimony, with some bismuth, and gives out when bent or bitten (which the modern English does in a far less degree), the well-known distinguishing crackle or *cri*. Modern German pewter is produced principally in Nuremburg, Crefeld, and Munich. The German alloys have in my opinion, however, the disadvantage of being more brittle than those used in this country, and I refer particularly to those used by the company with which my own name is associated. The alloys used by it are, as before mentioned, the results of careful trials made by

FIG. 11.



BEER TANKARD, WITH HANDLE.
(*Modern English.*)

my friend, Mr. Haseler, a partner in, and director of Liberty and Co.'s works at Birmingham. His endeavour has been to reproduce a metal similar, as far as possible, to the best of the old English pewter, and, in

point of solidity, the new alloy is, I believe, unequalled. The exact constituents and proportions used are regarded as a trade secret by my colleagues, as is the case with the composition of the alloy used by our German friends, although both could, doubtless, be readily assayed.

MANUFACTURE.

Pewter work is either cast, spun, or hammered, and the methods of manufacture differ in no essential in the present day from those of the olden times. Most of the old pewter was cast in moulds of brass, which were highly finished inside and fitted with great nicety. But specially prepared iron is preferred nowadays, as higher skill in the working of the more enduring metal has been attained. Pewter can be cast of any degree of thinness, and is turned out of the mould in a state requiring a minimum of work in the finishing process—apart from the inevitable polishing and soldering. In the active days of the Pewterers' Company, the Guild was accustomed to purchase, and to have made to order, a large number of moulds, which were let out on hire to its members. The latter, of course, also possessed stocks of moulds of their own, often held in shares by different tradesmen. The reason for this arrangement was the great expense of producing properly made moulds, and by this means the expense was shared by members to mutual advantage. The elaborate pieces encrusted with ornament in relief produced on the Continent during the Renaissance, especially in the 16th century, were cast in a different way, *i.e.*, in sand, and in sections afterwards soldered together. These pieces being produced in small quantities, the cost of a metal mould would have been prohibitive, since even for plainer work it was necessary to spread the cost of a mould over a great number of articles. The articles being cast in sand, however, left a finely granulated surface, requiring a considerable amount of extra labour to finish them by polishing and chasing.

FIG. 12.

TRAY, WITH GRIP HANDS. DESIGNED WITH HOLLOW RIM TO GIVE ADDITIONAL STRENGTH.
(*Modern English.*)

One of the most satisfactory pieces of old English pewter, and perhaps the example most frequently referred to, is a large dish in the South Kensington Museum, of which, by the courtesy of Sir Caspar Purdon Clarke, I have been enabled to bring a sketch here to-night. It will be seen that it is engraved with the Royal Arms and a floral border of simple design, and bears an inscription dated 1662. The engraving on it is plainly but boldly executed, and has the great merit of obtaining that too often ignored

quality, namely, suitability. But, as we have seen, the quality of English pewter as far as regards the metal employed was always unrivalled, and the strength and excellence of the workmanship was also equal to the best. In the department of design, however, we

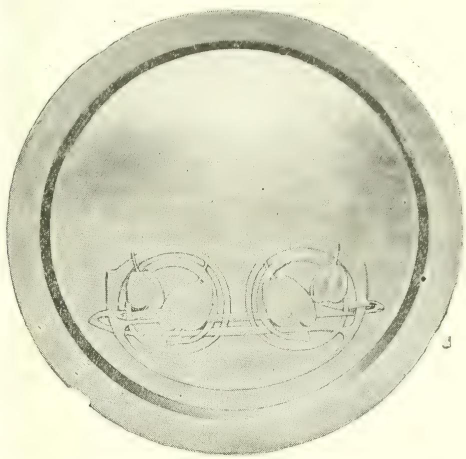
FIG. 13.

SAME, WITH EAR HANDLES, FOR GLASS FLOWER-BOWL. (*Modern English.*)

have nothing to show in old pewter to compare in elaboration with some of the pieces still existing, the work of continental craftsmen. I greatly prefer, however, the taste of our own workmen who made their platters and bowls almost always plain (and, therefore, more easily cleaned), depending on the shapes alone for the good effect of the cups, tankards and measures. The shapes of our old craftsmen's hollow ware are almost always excellent, and, generally, far superior to the classical ewers and vessels produced by the Frenchmen of the Renaissance. Our rivals on the Continent indeed, appear to have made the great mistake throughout of over-elaboration (for pewter is essentially a homely metal), with the inevitable result of subordination of shape to ornament. Some of the ewers and other vessels made by Briot, who has been called the Cellini of the pewterers, are, however, dignified, in addition to being elaborate. But, too many of the show pieces in the museums and private collections by German makers of the Renaissance period are both inferior in execution and absurdly overdone in decoration.

The solder used is still the hard solder of the Middle Ages, made of tin and lead, sometimes with a small proportion of bismuth, and when skilfully done, the process ensures not only mechanical adhesion, but forms an alloy of itself between the solder and the metals joined. The old pewterers strictly forbad the use of soft-solder (*i.e.* solder with too much lead); and although handles of jugs, &c., and the ears of dishes were at one time soldered, an ordinance made in the reign of Elizabeth decreed that in future they were to be cast in one piece. Modern hollow ware is often

FIG. 14.



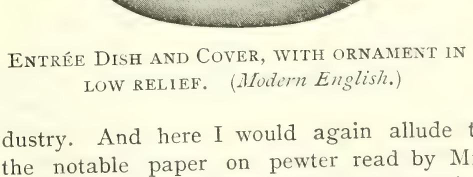
CARD TRAY, WITH CONCENTRIC ORNAMENT IN LOW RELIEF. (*Modern English.*)

"spun," as it is technically called, very much in the same way as clay on a potter's wheel. The metal is forced into the shape required by a blunt steel tool on to a wooden "chuck," or block, of the shape of the vessel to be made, and much of the ornament is worked by hand with the hammer and chaser. Some pieces are entirely hammered up from the sheets of pewter, and therefore bear the impress of individuality to a more marked degree.

THE REVIVAL.

I now come to the concluding and the more practical side of my subject—the revival of the pewterer's craft as an art in-

FIG. 15.



ENTRÉE DISH AND COVER, WITH ORNAMENT IN LOW RELIEF. (*Modern English.*)

dustry. And here I would again allude to the notable paper on pewter read by Mr. Gardner, ten years ago, and the interesting fact that no sooner had the echoes of his words of lamentation died away, than the cloud

which threatened extinction to the industry slowly lifted, and from that day the erstwhile moribund craft has been struggling back to life. Among the controlling influences tending towards this result, a certain firm, whose name I need not mention, had, shortly after that time, adopted for designs, in silver plate and jewellery, the *motif* and lines of ancient Celtic ornament. The results proving fairly satisfactory, the question arose, "Why not apply the like forms and designs to the manufacture of pewter?" Thus, rightly or wrongly, the pioneers of the revival of Celtic ornament decided to work in pewter on somewhat parallel lines with silver, and came to the conclusion that nothing is produced by the silversmith which may not, as occasion arises, be made in pewter, but with the distinct proviso, that any attempt to imitate the precious metal should be avoided. For pewter, however, only modifications of Celtic forms were used, and these were soon supplemented by floral and plant motives to which the distinguishing name of "Tudric" was given. This modest effort was, at all events, the first step towards the reawakening of the pewter industry, and, up to the present, it remains the only effort that has been made in England. It attained some commercial success, and, directly and indirectly, it has been the means of the revival, so far as a revival has at present progressed. But the ideal of modern English pewter, as conceived by its sponsors, aims at more than a commercial success—it aims at a high standard in design, a high standard in workmanship, and a high standard in the quality of the metal, and it strives to avoid over-modelling and over-chasing. It would devote attention to shapes being properly adapted to the several purposes for which the objects are made, it would see that the constructive lines be graceful, well contrasted, and strong, and that ornament, when used at all, be used with restraint, and grow out of the general design. These excellent intentions, unfortunately, are not always carried out, for faulty and eccentric notes strike out from time to time. These, however, it is confidently believed, are mere accidents by the way, and will doubtless become less and less frequent. The Germans are, practically, the only Continental representatives of the modern pewter industry, and they, having observed the new note struck in England, appear to have seized upon the fact that a change in the fashion of their own wares was desirable. So, forthwith, they proceeded to produce what they conceived to be an improvement upon the English work, and translated it into the fantastic *motif* which it pleases our Continental friends to worship as *l'art nouveau*. Still, alongside the foolish and undesirable, it must in justice be admitted that the Germans have recently produced many original and pleasing designs in pewter. I allude, particularly to the work of Messrs. J. P. Kayser and Sons, Messrs. Walters Scherf and Co., and Messrs. Lichtinger and Co. The present aim of the German pewterers seems to make for rather different results in certain details than with our designers, the ornament being made sharper and higher in relief, and the excess of antimony, or some similar alloy, used enables them to execute this kind of casting with great facility. As compared with goods made in this country, the surface-manipulation and finish of German goods is often more careful and satisfactory. On the other hand, our alloys are much less brittle, our work flatter and broader in treatment, and thus, it will, I

FIG. 16.

TRIPOD BOWL, TO HOLD GLASS DISH FOR FLOWERS. (*Modern English.*)

hink, be found that our designs and methods re more suitable to the capabilities of the ıetal, and are therefore better calculated to ›ermanently advance the pewter industry.

As for the lines on which to advance, it hould be remembered that for historic mansions and houses where the apartments are

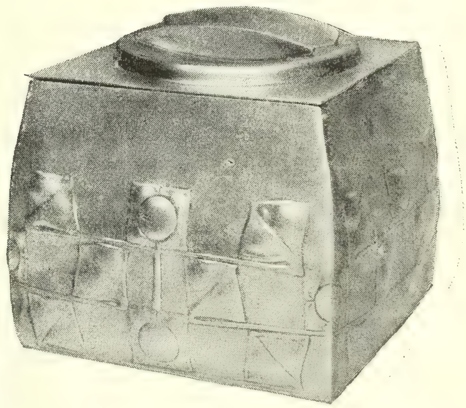
Fig. 17.

Cigar Box, with hammered ornament set with turquoise. (*Modern English.*)

furnished after the style of the Renaissance, and wherever magnificence is fitting and desired, a rich and sumptuous array of costly silver plate is doubtless in harmony with its surroundings. But, for the majority of households, I venture to think that pewter is equally desirable for the many decorative adjuncts of refined and restful furnishing, and the more particularly as it can be obtained at modest cost. On this latter point we are continually being told that objects of art should not be regarded as luxuries, but should be easily attainable by rich and poor alike. Everything, therefore, which tends towards the production of useful and beautiful objects at prices within the reach of all classes should be welcomed. And herein, perchance, in these days of culture, are to be found the future possibilities of pewter; for its soft neutral tone and subdued lustre harmonises with any scheme of decorative colouring. Those, too, who object to the use of electro-plate as an imitation of silver may be content to accept equally good forms in solid pewter in its place, whilst those who are already the fortunate possessors of treasures in pewter may contemplate with equanimity the advent of the burglar.

The manufacturer, however, realises that as by a process of natural evolution pewter has ousted wood from the kitchen, so china in its turn has inevitably supplanted pewter. The fact must be squarely faced by him, therefore, that it is useless to reproduce the large majority of those many fascinating forms in old pewter, where the purposes which brought them into being, are now attained by the substitution of other and more appropriate wares. For instance, however beautiful their form and patina it would be absolutely useless to tempt a modern housewife to purchase pewter plates and vessels for tea and table use, now that spotless and dainty-white porcelain cups and dishes are obtainable at equal or less cost. A recent author tells us, indeed, that "it is a good thing to rub pewter over with a rag saturated with vaseline," but surely the process appeals to the palate as the reverse of appetising, and is calculated further to emphasise the housewife's objection to pewter for culinary and table use. Then, too, besides the wares made for the service of food and other purposes requiring easy and perfect cleansing, there is a quite considerable range of other things once made in pewter, which an altered state of conditions has rendered useless. These, also, are undesirable for the modern pewterer to reproduce. The author just quoted writes, however, in reference to some of them: "Among other instances of articles in pewter which have now unfortunately ceased to be made are snuff-boxes, candle-boxes, table fountains, and

Fig. 18.



Biscuit Box, with handles on lid arranged in novel form. (*Modern English.*)

lavabos, or hanging-washstands." Now whilst sympathising with collectors in regretting the disappearance of the good work of bygone days, it would be a more helpful attitude for the manufacturer to try to substitute useful objects for the useless ones. Instead of table-fountains and candle boxes, one might

suggest the production of electroliers, jardinieres, and presentation caskets, challenge cups, card trays, and a host of et cæteras of the flower vase order. We have, indeed, an example of how a similar evolution was brought about by the Japanese metal workers, who, when they found that sword-hilts and their inlaying were no longer required, transferred their attention to the invention of the cheap and clever antimony-ware with which they have since flooded the European markets. And this antimony ware, be it remembered, is a branch of the pewterer's trade.

And now we come to the two questions which I have been working up to, *i.e.* (i) Are the pewter wares now being made equal in quality and design to the average work of the best periods of bygone days? And (ii) What are the future prospects of pewter as an art industry?

The latest critic on this subject, the writer just referred to, has not one good word for modern pewter. He says:—

"In striving to arrive at 'art' pewter, the manufacturers have produced the wrong kind of alloy. It is far too crude and white, and has a meretricious look, besides the fatal fault of almost looking like silver or electro-plate. Another fault is that it is far too brittle and hard. There is no nice feeling in it; it is, unlike old pewter, hard and repulsive to the touch. Again . . . . . satisfactory designs for pewter cannot be extemporised by any designer, however cunning he may be at catching the public taste—so called—with a gaudy cretonne or a meaningless wall-paper."

Happily, it is needless to add, there are many who hold more hopeful views on this subject, who consider a distinct advance has been made already, and who believe that there is good promise for the future. But perhaps the most practical way for us to arrive at a just conclusion is to examine some samples and then criticise them. I have, therefore, selected from among recent foreign and home productions a few of the most promising specimens. And in submitting them to this meeting I invite an opinion from more competent judges than myself. With this object I now propose to show a short series of enlarged photographs upon the screen; and afterwards invite attention to the specimens themselves, which are arranged for inspection in the room.

Lastly, I have much pleasure in drawing attention to the very interesting pieces of old pewter, which have been lent me for exhibition on this occasion, in order that we may contrast them with the new work. In this connection I desire to express my obligations to Mr. Walter Churcher, Mr. Oliver Baker, Mr. William J. Fieldhouse, Mr. Frank L. Pearson, the Rev. J. Pownall Britton, and other friends. And I take this opportunity to offer my warm thanks to my colleague, Mr. John Llewellyn, under whose fostering care the new developments in English pewter have been nursed into being.

Series of Pewter Pieces Lent by Mr. Walter Churcher.

1. Large Scotch Church laver, or baptismal flagon, 14 inches high, late 17th century.
2. Large Scotch Church laver, with spout, by William Hunter, of Edinburgh, *circa* 1750.
3. Quart covered flagon, with revenue mark, George IV. Bewdley make.
4. Barrel-shaped beer tankard, English, late 18th century.
5. Pewter inkstand, with sand dredger, late 18th century.
6 and 7. Dish and soup plate from Staple Inn, Holborn, by John Redshaw, date 1751. The owner has 13 such dishes and plates from Staple Inn.
8. Paten, *circa* 1663, dug from *débris* of Fire of London, formerly in the Mayhew Collection.
9. Circular alms, or rose water dish, with centre boss, *circa* Restoration.
10, 11, and 12. Set of three Tappit hens, or old Scotch beer flagons, *temp.* 1745. Old Scotch measure.
13. Plate, with reeded edge, by Thos. Taylor, *circa* 1670.
14. Plate, with scolloped edge, by Samuel Ellis, *circa* 1730.
17. Three old pepper castors, indicating variations in shape.
18. Old cash bowl, inscribed, "Sir, your quarter is up!" Late 18th century.
19. Domestic candlestick, early 19th century.

DISCUSSION.

The CHAIRMAN, in moving the vote of thanks to the author, said that the delightful paper with which Mr. Lasenby Liberty had favoured them possessed a two-fold interest, in its subject, and in the fact that Mr. Lasenby Liberty had himself initiated, and was still single-handed sustaining, the present happy revival in this country of the use of pewter. The charm of art was never so close, intimate, and grateful as when it was conferred on the familiar articles of utility about our hearths and homes. Its charm infinitely transcends in value the prices of the materials on which it is lavished, and can be equally imparted to the costliest

substances, black ebony and white ivory, silver and gold, and precious stones, and to comparatively worthless substances, clay, iron, copper, tin, brass, and pewter, and ordinary woods [Compare Lucan's "Jupiter the Tragedian," c. 51], provided the artistic manipulation of them is sympathetically adapted to the distinguishing natural qualities—and the defects of the same—of these materials, and to the uses the "objets d'art" fashioned of them are intended to fulfil. Just ten years ago, Mr. J. Starkie Gardner gave us his scholarly paper [*Journal*, 1 June, 1904] on "Pewter;" and in it, as Mr. Lasenby Liberty has told us, expressed a regret that pewter had not shared, up to that date, in the great artistic renaissance of the reign of Queen Victoria. This observation was at once taken up by Kayser, and by Lichtinger, in Germany, and in this country also by Mr. Lasenby Liberty, who for the past ten years has devoted himself, with the enthusiasm and resolution with which he pursues all his artistic enterprises, to the resuscitation of the ancient, and once flourishing and famous British art of pewtery. Mr. Lasenby Liberty to-night has fully and clearly, and in the spirit of the most impartial criticism, told us of all that has been attempted and done in this respect by his firm; and from the specimens of their work placed before us, and the illustrations of them in his lantern slides, we can judge of the difficulties of the undertaking, to which Mr. Lasenby Liberty has set himself as a labour of love, and of the measure of success with which these difficulties have been overcome. What is required of all such articles is that while artistic they should never lose their utilitarian and homely character; that is the character impressed upon them through untold generations of rough and ready domestic service. If this character is overlooked or ignored, or in any way blurred or masked, either in the form or the embellishments of these articles, if indeed it is not directly indicated and emphasised by their artistic treatment, the art elaborated on them has been wasted and is worthless,—however unencumbered by purposeless conventionalities, and unsignificant symbols, or however original in conception, and sincere in execution. The "summam alicui rei dare" to achieve here is directness, simplicity, and balance of form, the subordination of any ornamentation to the form, and to the interpretation of its function, and the perfect adjustment of both form and ornamentation to the materials of which these articles are severally framed, and to the human purposes they have to subserve. The decoration must not only be responsive to form and use, but as reticent as it is significant, and must avoid all excess. There must be no straining after originality, which unless it comes of the rarest and richest genius tends to languish under weak hands into nerveless and contemptible affectations and conceits, and in strong ones to run riot in violent and offensive eccentricities. In France, the contortionists of *l'art nouveau* have reached the basest artistic degradation in the studied pruriency of the nude decorative bronzettes with which the shop windows of all Europe have been crowded during the past three or four years. Compare them for a moment with the exquisite modelling, and the purity of conception which is their animating soul, of the clay figurines of the coroplasts of ancient Tanagra and Thisbe, Cyme and Myrina, and you at once realise the gulf fixed between the inspirations of artistic genius and the diabolical subtleties of merely manipulative dexterity. There is, moreover, nothing new in this *l'art nouveau*. It is, in its "motifs," the primitive art of all savage races, to which the highest mechanical perfection is found given in the art of ancient Egypt, and in much of the ritual art of modern Japan, which Celtic art all but touched with spiritual perfection, and which in our time has been brought into vogue by the marvellous black and white drawings of Aubrey Beardsley, a man of undoubted genius, but who, it should always be remembered, received his artistic training as an architectural draughtsman; and again by the seductive jewelry of Lalique, and cameo-cut glass of Gallé. But at its best it is not of true artistic inspiration, but an intellectually conceived and calculated mannerism, foredoomed in the hands of mediocrities to the fate of all mechanical imitations. Truly artistic decoration, in its whole scheme, and in every detail, is ever as spontaneous and free as the beauty, and grace, and sweetness, of the "all a blowin' all a growin'" flowers of the Thames' side meadows of a morning in May. You will apply for yourselves these summary canons to the actual examples, and to the lantern illustrations, shown to you by Mr. Lasenby Liberty. Meanwhile he would read to them a letter on the subject of Mr. Liberty's paper, just received from Mr. Starkie Gardner from Algiers.

The Chairman, in continuation, said he would now only hasten to add that in the history of the great renaissance of British art in the 19th century Mr. Lasenby Liberty would always occupy a well-defined and honourable place of his own, not simply on account of his public spirited efforts to revive the truly native* art of British pewtery, but because of the stimulus given by him during the past thirty years to all the "applied arts," so called, concerned in furnishing and household decoration. He will always have his niche beside such men as the late Sir Henry Doulton, and Sir Thomas Wardle, men who, with true artistic passion, devoted their inherited position in lucrative departments of business to bring beautiful things in the way of earthenware, and china, and glass, and carpets, and hangings, and upholstery, and metal work, and cutlery, within the means of middle-class people throughout this country. He emphasised the phrase,

* The word "pewter" is also a wholly native word, being derived from the older native forms of "peltre" and "spelter," from which are also derived the Spanish *peltre*, Italian *peltro*, French *peautre*, &c. Pewterer ['electuarius v. stannarius, *Promptorium Parvulorum*] and Pewtress, also Powter are very old English family names.

"middle-class," for the mansions of the great, and the cottages of the peasantry, until the latter were desolated by the economic action of free trade, had always been artistic, and it was the modern middle-class who created the Philistia in which they had their habitation down to 1851. Ruskin and Rossetti, Norman Shaw and William Morris, and later Walter Crane and Lewis Day, quickened the remarkable artistic renaissance of the Victorian era into being, and the special service of Mr. Lasenby Liberty has been to adopt this revival as a basis of commercial enterprise, and, within the limits imposed by the conditions of business, to carry the influences of a great intellectual and moral regeneration into every middle-class home, by the popularisation of all the applied arts conducive to the health and comfort, the refinement and elevation, of our English domestic life. This is not an adventure that could have appeared likely to prove in the least profitable to the mass or ordinary business men of the passing generation of Englishmen, or to business men of any generation or country who did not love their art above their trade; and it is in this consideration that we have the exact measure of the gratitude due by all students and lovers of art, and of our national home life, to Mr. Lasenby Liberty: whose name is now absolutely identified with the new Domestic Art of the United Kingdom, and has become a household word throughout the length and breadth of the British Empire,—giving a fresh reading, if I may venture the pun on his name, to the hackneyed Ciceronian phrase:—"Imperium et Libertas"

[The following is Mr. Gardner's letter to the Chairman.]

"I would have attended the meeting to hear my friend Mr. Liberty discourse on so interesting a subject as pewter, but I am far away, enjoying a delightful cruise. When I read my paper, now several years ago, on the same subject, the old pewterers' trade seemed verging to extinction, and the new arts and craftsmen had hardly turned their attention to pewter. I suppose something may be said as to the relative merits of hammered and of cast pewter. I have never met a piece of old pewter that was not cast, and I suppose that practically cast pewter will always have the preference. My own experience is that, unlike zinc or lead, castings in pewter cannot be left untouched from the mould as a 'tinny' skin is formed in cooling which has an unpleasant colour. To get the colour value of the alloy this has to be removed, and hence forms that can be turned on the lathe have always been preferred, at least in our country, conferring an air of simplicity on English pewter which is not without its charm. Much of the mediæval pewter was of more enriched form, the skin either chased off or left to be removed by use. The only pewterer of any note, whose name deserves to be recorded, is that of the extraordinary gifted die sinker, Francois Briot, who lived in the reign of Francis I., I think at Montpelier, where there was a mint. He seems to have produced in his leisure time a mould for a very richly designed rose-water dish, illustrating temperance, which so far as examples have been handed down is superior in the delicacy of modelling to anything contemporary made in silver. Several castings from it are in existence, in an alloy which is chiefly tin, carefully chased. The design appears to us over elaborated, but it was appreciated in its day, since Bernard Palissy copied it in pottery. A German, Caspar Enderlein, reproduced the mould and made castings which he stamped with his own name. A ewer and tankard are also attributed to Briot. Some modern works in pewter have been produced in France, rivalling the works of Briot in elaboration, but probably we should all agree that for pewter, an excess of elaboration is particularly undesirable. With a metal so soft, and intended for daily use, the surfaces cannot be too plain, and nothing gives the colour and richness like a hand polish, acquired by daily use. An artistic outline and broadly bossed surface, such as we sometimes meet with in mediæval or German Renaissance pewter and silver, is to my mind the best and most effective treatment. I do not care for oxidised effect with small ornaments such as flowers, masks, &c., and cannot insist too strongly on decoration being practically limited to broadly bossed curving facets.

"One of the finest and most artistic examples of the treatment of pewter I have seen is the flagon with a bold inlay of brass of arabesque design, formerly in the Gurney collection, and now, or until lately, deposited in the Victoria and Albert Museum. The harmonious contrast of subdued brass and pewter is in this case most exquisite. Perhaps Mr. Liberty will turn his attention in the direction of inlays. I much regret that I am not able to contribute to the discussion. It will I know interest Mr. Liberty to hear that I am making a chandelier in pewter, the design being formed of the prows and foremost rigging of four 16th century ships. In this case I made the model to cast from in beaten copper, thickened with wax at the back."

Mr. W. H. HASELER said that he rose with much diffidence in the presence of experts. He was himself a collector, and therefore a fanatic. Mr. Liberty had referred to the criticism which had been made to the effect that modern pewter looked too lustrous, and that the old pewter had a more delicate tinge. But in the French manuscripts of Queen Elizabeth's time, the pewter upon the tables of the English nobility was spoken of as shining like silver. He believed that the pewter referred to was 90 per cent. pure tin, and that when the articles were new, and were in constant use, they would no doubt shine almost as brightly as pure silver itself. There was one side of the pewter industry, and one side of collecting articles which had not been touched upon in the paper; and if Mr. Liberty ever thought of putting

another tool into the hands of his enemy by writing a book they would all be most grateful if he would refer to that point. The habits and history of the people of former times, and facts connected with their homes and their lives, could be learned from the articles which they used, and it was that fact which made collecting not only valuable and instructive, but—to him at any rate—particularly fascinating. No doubt the old pewter was made chiefly for use, and whatever ornament it bore, grew out of the maker's natural feeling, but the use of the article determined its form. The beauty of it consisted in its being perfectly adapted to its use. People three or four hundred years hence would be able to understand something of the lives and the homes of the people of the present day, and judge of the sort of people they were, by a study of the domestic utensils which were now used, and he thought that that ought to suggest the lines upon which modern pewter should go. He, in common with the Chairman, disliked the modern German pewter. He had come up from Birmingham on purpose to hear the paper, and he must express his deep thanks to Mr. Liberty for the pleasure which he had given him, and for the information which he had imparted. He only hoped that Mr. Liberty might supplement the paper of this evening by a further paper, giving them the history of the ancient pewter, and dealing with the many points of interest which that history possessed.

Sir THOMAS WARDLE said that he was not at all technically acquainted with the subject, and he would ask the meeting to excuse him if what he had to say he said in his own way. He had been very much reminded of days gone by when his old friend William Morris and he used to ramble in North Staffordshire amongst the farmhouses to see and to collect what they could of old pewter. The zeal of William Morris for that material with its beautiful shapes was profound, as also was his knowledge. He was sure that William Morris and Mr. Liberty might be associated in thought as embellishing by their great taste everything in which they felt interested, whether it was plastic, malleable, or textile. None of the materials with which they had both dealt had occupied their time and their taste without being illuminated and beautified, and he quite agreed with the words of Sir George Birdwood that Mr. Liberty's work had made its mark, and would make a still greater and lasting mark on this age. He might be allowed, perhaps, to say, by way of diversion, that there was one amalgam or pewter, of which Mr. Liberty had not spoken, but which he did not think Mr. Liberty would touch with a pair of pewter tongs. He alluded to the modern adulteration of the fibre of silk by chemical weighting. A few years ago a Lyons dyer came to him, and asked him if he thought it was of any use to go down to the tin mines of Cornwall to purchase tin. He (Sir Thomas Wardle) said "Why?" The dyer answered, "We are now using tin to such an extent in dyeing that it would pay me to go to the tin mines to buy ore and take it down there to smelt." Speaking of analysis, he might say that he had had occasion to analyse many times this new substance. It contained generally about 50 per cent. of tin, about 5 per cent. of phosphorus, and the same amount of sodium and silica and the rest silk; but the curious point of it all was that it was neither malleable nor ductile, but it could be woven. It was simply a fraudulent adulteration of the fibre of silk. Such was the progress of chemistry and fraud that scarcely any of the silk which ladies wore and which came from abroad at the present time was not adulterated in about the proportions which he had mentioned, especially with tin and the other articles.

Sir ERNEST CLARKE said that he came from a part of the country where ancient pewter was at one time common, having been used in monastic days for all domestic purposes. There were still some old pieces preserved in county houses, but, as Mr. Liberty had said in his paper, a great number of the old pewter articles had been melted down because they contained silver. His interest in modern pewter arose from a visit which he paid to Berlin last August, when he was amazed to see the new developments, of which they had specimens represented on the screen that evening. He regretted that this new art should have all those "squirmings and convolutions" to which reference had been made by the Chairman. Undoubtedly the use of pewter was for homely articles, and, the simpler the form, the better they would like them and the sooner they would get accustoned to them. In England it took time for the people to take up any new material, and he was sure that the introduction of the articles imported as "made in Germany" would put back for a considerable time to come what would be a most useful means of decoration in simple English homes. There was no doubt that electro-plate and Sheffield plate had had their day. Silver even at modern prices was beyond the means of the middle-class purchaser. But he thought there were many articles of which Mr. Liberty had spoken in his admirable paper which might very well be made in pewter, and which they would be very glad to have, as being durable and artistic and beautiful in their way. He should like to add his own personal thanks to Mr. Liberty for the trouble that he had taken to put before them in such a charming manner the results of his great erudition on this as on other subjects. Mr. Liberty was, undoubtedly, entitled to go down to posterity as one of those who had assisted in making our homes more beautiful. Nothing which the Chairman had said was too strong to express their appreciation of what Mr. Liberty had done towards the artistic decoration of English homes.

Mr. ALFRED EAST, A.R.A., said that it gave him great pleasure to say a few words, for he recognised

not only that Mr. Liberty had given them a history of the pewterer's art, and records connected with it in this country and in Europe, but that he had been himself the means of reviving an art which had a very peculiar interest, from the fact that the pewterer's art in England was almost a native art. That fact ought to appeal to English people. The specimens which Mr. Liberty had put before them would show that the pewterer's art in its revival had made an advance in forms. In all revivals there was an attempt at ornamentation; but this metal, perhaps, was not capable of sustaining the same ornamentation as the precious metals. He thought that they were sufficiently acquainted with the decorative art to understand that in some of the German things which had been shewn there was an extravagance of expression in the decoration. Personally he was grateful for this paper, for it had given him a wider outlook into this interesting branch of applied art. No man in England was a higher authority on such matters than Mr. Liberty, and for that reason he had listened to him with very great respect.

The vote of thanks to Mr. Liberty proposed by the CHAIRMAN, was carried unanimously.

Mr. LIBERTY, in reply, said that he could only express his very deep and heartfelt thanks for the extremely kind way in which the paper had been received, and for the kind words which had been used by the Chairman, whom he had long had the privilege of calling a friend, and by the other speakers.

Miscellaneous.

ADMIRALTY CHARTS.

The following is the official list of charts issued by the Hydrographic Department of the Admiralty, in March and April last:—

New Charts.—No. 3420—England, south coast:—Yealm river. 3418—England, south coast:—St. Germans or Lynher river. 3367—Channel islands:—Island of Jersey. 2339—North sea, general chart. 3410—France, south coast:—Gulf of Foz. 3428—Grecian archipelago; Lemnos island:—Port Kondia. 3404—North American lakes; lake Superior:—Coppermine point to cape Gargantua. 3408—West Indies:—Puerto Rico. 3421—Scotland, west coast:—Broadford bay. 3387—North America, west coast; Vancouver island and British Columbia:—Johnstone strait; sheet III. (west);—(plan:—Forward bay). 1789—China sea:—Channels, between Sumatra, Linga and Singkep. 3371—Philippine islands:—Libukan islands to Naro bay. 1394—China sea; gulf of Siam:—Entrance to Kuantan river; entrance to Pahang river; entrance to Rumpin river, Joara bay. 3385—China, east coast; Hongkong:—Aberdeen harbour. 3365—Korea, south-west coast:—Port Hamilton to Mackau group. 3366—Korea, south-west coast:—Fusan harbour to Port Hamilton. 3397—Japan; Nippon, north-west coast:—Hamada ko and approaches. 3412—Tasmania, north coast:—Hunter passage. 3419—Australia; Torres strait:—Goode island anchorage. 3403—Solomon islands:—Ysabel island (eastern part). 3402 — Solomon islands: Ysabel island (western part). 3335—Approach to strait of Belle isle; plan added:—outer soundings off Belle isle. 3008—Anchorages in south-east Alaska; plan added:—Killisnoo harbour. 1006—Gulf of Aden; Ras Galweni to Ras Hafún; plan added: — anchorage of Bander Laskhorai. 3047—Red sea; harbours and anchorages; plan added:—Khor el Wahla. 930—Sulu sea; anchorages between Borneo and New Guinea; plan added:—Ingelas bay. 2772—Sulu sea; anchorages in Gillolo; plans added:—Ternate road and channel; Jailolo road. 2196—Celebes; sketch plans of anchorages in the southern part of Celebes; new plan:—Kali Susu anchorage; plan added:—Kabaena island, south point anchorage. 3395—Japan; plans on the west coast of Nipon; plan added:—Funakawa wan. 500—New Hebrides; anchorages in Malekula island; plan added:—Lambumbu harbour. 329—Solomon islands; Bougainville strait; plan added:—Shortland harbour. 1141—Islands in the North Pacific; new plan:—Laysan island.

Charts that have received additions or corrections too large to be conveniently inserted by hand:—

Nos. 2476—Scotland, west coast:—Frith of Lorn. 1974—Norway:—Jœlöen to Christiania. 2312—Norway; sheet X.:—Lofoten islands to Andö. 2317—Norway; sheet XV.:—Tana fiord to Varangar fiord. 2313—Norway; sheet XI.:—Andö to Helgö. 2297—Gulf of Bothnia; sheet II. 173—Baltic sea.—Approaches to Helsingfors and Sveaborg. 2247—Gulf of Finland:—Hogland to Seskär. 77—Spain, north coast:—Bay of Gijon, &c. 1614—Falkland islands:—Stanley harbour. 2733—Iceland:—Portland to Snefells Jökel. 2978—Iceland:—Sigle fiord to Niardvig. 2980—Iceland:—Storksnæs to Portland. 2489—United States, east coast:—Nantucket sound and approaches. 2491—United States, east coast:—Approaches to New York. 3204—United States, east coast:—New York bay and harbour. 2859—West Indies:—Plans on the south coast of San Domingo. 2544—South America, east coast:—Rio de la Plata. 1749—South America, east coast;—Monte Video to Buenos Aires. 2887—United States, west coast:—San Pablo and Suisun bays. 2431—Alaska:—Port Simpson to Cross sound. 2812—Africa, west coast:—Lagos harbour. 1003—Africa, east coast:—Pungue river. Beira harbour. 942A—Eastern archipelago, eastern portion. 1696—Eastern archipelago:—Lombok to Flores. 2575—Celebes sea, eastern part. 957—Philippine islands:—Ports in. 2578—Philippine islands:—Eastern part of the Sulu or Mindoro sea. 2577—Philippine islands:—Between St. Bernadino and Mindoro straits. 854—China, east coast:—Port Swatau.

423—New Zealand:—Port Nicholson. 782—Pacific ocean: North-east sheet. 731—Gilbert islands (Kingsmill group). 732—Gilbert islands:—Makin or Taritari, Tarawa, &c. 157A—New Hebrides:—Malo to Efate island. 936A—New Caledonia, north-west part.

These charts are issued by Mr. J. D. Potter, 45, Minories.

COAL, STEEL, AND IRON PRODUCTION IN FRANCE.

The production of anthracite and bituminous coal in France in 1903, was, according to recent statistics issued by the French Minister of Public Works, 34,317,527 metric tons (2,204 lbs. each), an increase of 4,952,480 tons as compared with 1902, and the largest output known since the mines were worked. In a decreasing order of importance of production the coal basins of the departments of Nord, Pas de Calais, Loire, Gard, Bourgogne, Nivernais, Tarn, Aveyron, and Bourbonnais showed the greatest tonnage, having produced together 28,000,000 tons in 1902, and 32,000,000 in 1903, of which amount the Nord and Pas de Calais fields alone produced 18,250,000 tons, and 22,080,000 tons respectively. The official statistics for 1903 do not separate bituminous from anthracite coal, but the production of coal in 1902, was divided as follows:—Bituminous, 27,928,000 tons; anthracite, 1,437,000; and lignite, 632,000; total, 29,997,000 tons. The production of lignite in 1903 was 685,465 tons, as compared with 632,423 tons in 1902, an increase of 53,042 tons. Ninety per cent. of the total output of lignite was mined in the departments of Bouches du Rhone, Basses Alpes, and Vaucluse. In France, in 1902, there were 642 coal grants, according to the United States Consul at Havre, embracing a superficial area of 1,370,000 acres. Of these, however, only 381 grants, with an area of 988,000 acres, were worked, 315 grants producing bituminous and anthracite coal, and 66 grants lignite. The approximate consumption of coal, coke, and briquettes in France during 1903 was 47,000,000 tons, an increase of 4,630,000 tons as compared with 1902. The production of pig-iron in 1903 was 2,827,668 tons, an increase of 422,694 tons, as compared with 1902. The principal centres of production were the departments of Meurthe and Moselle, with 1,888,143 tons; Nord with 282,381 tons; Saone et Loire with 87,438 tons; Pas de Calais with 85,188 tons; Landes with 75,029 tons; Haute Marne with 52,601 tons, and Gard with 50,838 tons. There were 595,931 tons of manufactured iron produced in France during 1903, a decrease of 43,740 tons as compared with 1902. The production of manufactured steel in France during 1903 was 1,317,400 tons as compared with 1,245,806 tons in 1902, an increase of 71,594 tons. There were 234,494 tons of steel rails produced, a decrease of 39,318 tons in comparison with 1902; 792,702 tons of commercial steel, an increase of 94,814 tons; and 290,204 tons of sheet steel, an increase of 16,098 tons.

Correspondence.

STATISTICS OF IRON AND STEEL INDUSTRIES.

Mr. Digby will, I hope, excuse my replying somewhat bluntly to his answer—which I have just seen in the *Journal* of the 16th inst.—to my criticism of his paper, to the effect that what appeared to be his main argument was either irrelevant or incomplete.

He conveniently avoids attempting to make out its relevance, and ingeniously tries to show that he cannot complete the calculation, because he says it would be misleading, forgetting, or not seeing, how misleading his present calculation is, in its one-sided form. He thus gets himself into the absurd position that while he artificially increases the figures of our trade by measuring them in food supplies, he says he cannot do this also for America and Germany, because those countries produce their own food wholly or largely, and do not import so much as we do. He might as as well plead that a comparison would be misleading because we do not eat pop-corn nor German sausage.

Mr. Digby claims that his calculation affords ground for satisfaction, but both appear to be practically meaningless. We all know that food supplies are cheaper than they used to be but our competitors are, if anything, better off in that respect than ourselves. Why, then measure the iron and steel trade in food supplies? Why not, if irrelevant calculations are to be made, measure it in coal or in rates and taxes? To measure the iron trade figures in coal-purchasing power would be far more relevant than to do so in food supplies, but doubtless it would not suit Mr. Digby, who, in spite of his magnificent protestations of impartiality, refuses even to endeavour to be consistent.

Mr. Digby also declares in a beautiful phrase, that "before a definite verdict can be pronounced the internal consumption must be determined." What is the meaning of this? What verdict? What consumption? The internal consumption is known in regard to iron and steel, and better known probably than in any other industry.

Presumably, however, Mr. Digby despises the uncomplicated and undeceiving tonnages, and requires elaborate estimated money values of all the manufactured varieties of the metal, in order to multiply them in food supplies, or to apply some other artificial stimulant to the figures, and produce a kind of statistical mist in which he may beam with imaginary satisfaction.

It would seem that the advocates of "Free Trade" generally contend that our position is satisfactory, or

that it cannot be ascertained. This attitude cannot be regarded as scientific, and the real case against fiscal reform, is based upon the legitimate doubt of what the precise effect may or may not be, of any economic policy or change of policy.

All advance in knowledge and welfare, however, has been obtained by experiment, and that it is the duty of the nation to make the experiment of revising taxation by means of a tariff appears to be obvious, in view of the example of other countries and the colonies, if for no other reason.

If the tariff policy be such a mistake as Free Traders allege, they should be the first to consent to the experiment being tried, as the only scientific method of proving its fatuity.

GEORGE S. BURT.

4, Lothbury, E.C.,
30th May, 1904.

Obituary.

SIR DONALD HORNE MACFARLANE.—Sir Donald Macfarlane, East India merchant, and a member of the Society of Arts since 1874, died on Thursday, 2nd inst., at Harley-house, Regent's-park. He was born at Caithness in July, 1830, the youngest son of the late Mr. Allan Macfarlane. He represented county Carlow in the Home Rule interest in the House of Commons from 1880 to 1885, and Argyllshire in the short Parliament of 1885–86, and again in that of 1892–95. He was knighted in 1894.

General Notes.

PHYSIOTYPE.—As the name implies, this is a new method of obtaining printed impressions from animal or vegetable life. The subject to be reproduced is placed on a sheet of paper and pressure is applied; this leaves a hidden design on the paper—strong or light, according to the amount of natural oils or moisture contained in the subject. This design is then developed by the aid of a coloured powder, which is dusted over the impression; this brings the complete print into view in a strong permanent colour. If necessary, the impressions can be made and remain undeveloped for a considerable time—three months have elapsed between printing and developing some of the work done by the inventor. The process is specially adapted for finger printing, as it is no longer necessary to blacken the fingers with pigments. Pending the publication of the inventor's patent specification, full details cannot be published, but it may be stated that prints can be made on any ordinary paper, though the best results are obtained on the paper prepared for the purpose. The whole process is a speedy one, and takes less than a minute to make an impression and develop the print.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, JUNE 13...Geographical, University of London, Burlington-gardens, W., 8½ p.m.

TUESDAY, JUNE 14...Asiatic, 22, Albemarle-street, W., [illegible] p.m.

Medical and Chirurgical, 20, Hanover-square, W., 8[illegible] p.m.

Anthropological, 3, Hanover-square, W., 8½ p.m.

Colonial Inst., Whitehall-rooms, Whitehall-place, S.W., 4½ p.m. Sir Cavendish Boyle, "Newfoundland, the Ancient Colony."

WEDNESDAY, JUNE 15...Meteorological, 70, Victoria-street, S.W., 4½ p.m. 1. Rev. C. F. Box, "Effects of a Lightning Stroke at Earl's Fee, Bowers Gifford, Essex, April 13th, 1904." 2. Mr. A. Lawrence Rotch, "An Instrument for determining the True Direction and Velocity of the Wind at Sea."

Microscopical, 20, Hanover-square, W., 8 p.m. 1. Prof. J. D. Everett, "A Direct Proof of Abbe's Theorems on the Microscopic Revolution of Gratings." 2. Mr. F. W. Millett, "Report on the recent Foraminifera of the Malay Archipelago" (Part xvi). 3. Mr. F. Enock, "Nature's Protection of Insect Life."

Chemical, Burlington-house, W., 5½ p.m. 1. Mr. A. D. Hall, (*a*) "The mechanical analysis of soils and the composition of the fractions resulting therefrom;" (*b*) "The effect of the long continued use of sodium nitrate on the constitution of the soil." 2. Mr. A. Scott, (*a*) "The decomposition of oxalates by heat;" (*b*) "Some alkyl derivatives of sulphur, selenium, and tellurium." 3. Messrs. E. C. C. Baly and C. H. Desch, "The ultra-violet absorption spectra of certain enol-keto-tautomerides. Part. I. Acetylacetone and ethyl acetoacetate." 4. Mr. J. N. Collie, "The action of acetyl chloride on the sodium salt of diacetylacetone and the constitution of pyrone compounds." 5. Mr. W. P. Bloxam, "Our present knowledge of the chemistry of indigo."

British Archæological Association, 32, Sackville-street, W., 8 p.m.

THURSDAY, JUNE 16...Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Linnean, Burlington-house, W., 8 p.m. 1. Dr. Walter Kidd, "Variations in the Arrangement of Hair in the Horse." 2. Mr. W. Fawcett and Dr. A. B. Rendle, "An Account of the Jamaican Species of *Lepanthes*." 3. Dr. A. D. Waller, "The Blaze—Currents of Vegetable Tissues." 4. Mr. James Cash, "British Freshwater Rhizopoda." 5. Mr. A. F. Brown, "Notes on the 'Sudd' Formation of the Upper Nile." 6. Mr. P. Olsson Seffer, "The Place of Linnæus in the History of Botany."

Historical, Clifford's-inn Hall, Fleet-street, E.C., 5 p.m.

Numismatic, 22, Albemarle-street, W., 6½ p.m. Annual Meeting.

Mining and Metallurgy, at the Rooms of the Geological Society, Burlington-house, W., 8 p.m. 1. Messrs. J. S. Haldane and R. Arthur Thomas, "The Cause and Prevention of Miners' Phthisis." 2. Discussion on Mr. Henry C. Jenkins's paper, "Note on an Exhibit of an Emergency Set for First-Aid Treatment of acute Cyanide Poisoning." 3. Discussion on Mr. J. H. Collins's paper, "The Assay of Tin, and the Solubility of Cassiterite" 4. Mr. W. Fischer Wilkinson, "Iron Ore Mining in Scandinavia." 5. Mr. H. D. Griffiths, "Notes on the Crib-Setting of a Deep Level Shaft."

FRIDAY, JUNE 17...Quekett Microscopical Club, 20, Hanover-square, W.C., 8 p.m.

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FRIDAY, JUNE 17, 1904.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

ANNUAL GENERAL MEETING.

The Council hereby give notice that the One Hundred and Fiftieth Annual Meeting for the purpose of receiving the Council's Report and Treasurers' Statement of receipts, payments, and expenditure during the past year, and also for the election of officers and new members, will be held in accordance with the By-laws on Wednesday, 29th June, at 4 p.m.

(By Order of the Council),
HENRY TRUEMAN WOOD,
Secretary.

ADDITIONAL MEETING.

An additional meeting of the Society will be held on Wednesday, June 22nd, at 5 o'clock, when a lecture, in connection with the London meeting of the "International Olympic Games Committee," on "The Northern Games in Stockholm and Sweden and its People" will be given by Colonel Viktor Balck, President of the Northern Games Committee. The Right Hon. the Lord Chief Justice, G.C.M.G., will preside.

The Northern Games include Skating—Distance and Figure; Sleighing with Horses, Reindeer, and Teams of Dogs; Ski Running; Ski Jumping; Horse Racing in Snow; Ice Yachting, &c.

After the lecture Baron P. de Coubertin, President of the International Olympic Committee, will give a short account of "The Revival of the Olympic Games."

Members besides having the right of admission, can admit one visitor to the meeting by the use of the usual tickets.

CONVERSAZIONE.

The Society's Conversazione will take place at the Royal Botanic Gardens, Regent's-park, on Monday evening, June 27th, from 9 to 12 p.m.

The central portion of the Gardens only will be used. The Gardens will be illuminated with coloured lamps, and also by the Kitson Incandescent Oil Light. The Conservatory and the Club House will be open.

An Exhibition of Growing and Cut Roses and other Flowers will be arranged in a marquee in the grounds by Messrs. W. Paul and Sons, of Waltham Cross.

A Selection of Music will be performed by the String Band of the Royal Artillery in the Conservatory, and by the Band of H.M. Irish Guards in the Gardens, commencing at 9 o'clock.

A Vocal and Instrumental Entertainment, under the direction of Mr. H. Tipper, will be given at intervals in the Club House.

The reception by Sir William Abney, K.C.B., D.C.L., F.R.S., Chairman, and other Members of the Council, will be held at the entrance of the Conservatory, near the Broad Walk, from 9 to 10 o'clock.

Each member is entitled to a card for himself (which will not be transferable), and a card for a lady. The cards are now in course of issue. In addition to this, a limited number of tickets will be sold to members of the Society, or to persons introduced by a member, at the price of 5s. each, if purchased before the date of the Conversazione. On that day the price will be raised to 7s. 6d.

Members can purchase these additional tickets by personal application, or by letter addressed to the Secretary. In all cases of application by letter a remittance must be enclosed. Each ticket will admit one person, either lady or gentleman.

Tickets will only be supplied to non-members on presentation of a letter of introduction from a member.

Light refreshments (tea, coffee, ices, claret cup, &c.) will be supplied.

Proceedings of the Society.

INDIAN SECTION.

Tuesday afternoon, May 31, 1904; SIR JAMES L. MACKAY, G.C.M.G., K.C.I.E., in the chair.

The CHAIRMAN said that Mr. O'Conor had spent practically a lifetime in India, having been in the service of the Indian Government for something like 40 years; and his name had now a world-wide reputation as an economist and statistician. He created and built up the Statistical Department of the

Government of India. In retiring from the position of Director-General of Statistics a year or two ago, Mr. O'Conor left the Department in a condition which enabled the Government of India to turn out an annual report in regard to the trade, commerce, and economic condition of that country which was second to none of like reports produced in Europe.

The paper read was—

THE ECONOMIC AND INDUSTRIAL PROGRESS AND CONDITION OF INDIA.

By J. E. O'Conor, C.I.E.
(Late Director-General of Statistics, India).

The subject on which I have the privilege of addressing you to-day is in its nature one for quiet, well-reasoned discussion, leading up to conclusions interesting and suggestive to the administrator, the legislator, the economist, the publicist, and to the people who rule those vast possessions which constitute the Indian Empire. But no subject has lent itself more frequently and constantly to controversial and heated argument by politicians of opposing schools. Even the question of fiscal policy is second to it in this respect, for fiscal policy came on to public platforms and into the newspapers only during the past year, while the economic condition of India has been worried by adversaries for generations, since the controversy began when the commercial monopoly of the East India Company became offensive to independent traders and its termination was demanded as an indispensable preliminary to the freedom from commercial shackles of a country groaning under the tyranny of a mercantile oligarchy. That claim was made before the end of the 18th century; the monopoly was abolished in 1835, but the controversy has continued ever since, in varying phases and by different sets of combatants. One party declares solemnly that everything is for the best in India, that the world has never seen such an admirable administrative system before, that no other nation could have done anything like it, that the results must commend themselves alike to gods and men, that India is always prosperous as the outcome of just and well-ordered government, except at intervals, when cosmic forces intervene to devastate the land with drought and famine. Another party comprehensively denounces the whole system in principle and in practice, in the mass and in detail, alleges that the country makes no progress, that it cannot make any under such an administrative system, that it is slowly starved and bled year by year, and that the ravages of famine—which ought to be prevented if the Government did its duty intelligently, or handed the business over to some other agency—merely aggravate the insidious work of the Government or, indeed, are the consequence of that work.

I belong to neither party and have no desire to take a hand in these polemics. I address you now for the purpose of stating the impressions of Indian economic conditions acquired during a prolonged period of service in offices which gave me the best opportunities for acquiring information first-hand and of measuring and assessing its value, and for considering what were the most useful measures that might be adopted by the State and by the public for the promotion of commerce and industry. For a long term of years it was my duty to tabulate and record the facts of Indian economics and to discuss their tendency and meaning. I may, I think, fairly claim to be an independent and impartial observer, who looks at his subject in the clear dry light of reason, unobscured by the mist and dust raised by prejudice and passion, and who is not given either to unqualified adulation or to the delivery of brawling judgments.

Looking at the economic progress of India in this way, it seems to me that, as with many other controversies, there is something to be said for both parties to the argument, though not all, or perhaps nearly all, that is claimed by each, and that the truth lies somewhere between the two. The conclusion I have formed may be stated very briefly in a few words :—India has made very great progress, and much of it is due to the really splendid work of the Administration ; but allowing for all the marked advance which has certainly been made, and for the excellence of the Administration, there is no doubt that India is still an extremely backward country in comparison with Western nations, that in many respects the conditions are still quite rudimentary, that this backwardness is due to various causes, for the existence of most of which the State is not directly responsible, and is not due to administrative crimes ; but that the conditions might be considerably modified and improved by administrative measures which should be brought into operation.

Let us now review, so far as the time at our disposal will admit, the facts and considerations which lead up to these conclusions. It may be said that the whole of the economic

progress of India is the work of the last forty years. At the outbreak of the great Mutiny of 1857 the making of India had not in fact as yet begun. Railroads were unknown except for a short line which had just been laid for a few miles from Bombay and another from Calcutta, the first section of the line which has since been carried through to Peshawar on our North-Western frontier, and there were no roads worth mention or fit to use save as fair-weather tracks, except the Grand Trunk road, which was constructed mainly for military purposes. The means of locomotion were of the most primitive. The rivers formed the highways, travellers and merchandise going up and down in crazy boats until a few years before the Mutiny, when a service of small river steamers was initiated on the Ganges between Calcutta and Allahabad. The traveller by road entrusted himself to a palankeen borne on the shoulders of men through jungles abounding in wild beasts, in much the same style as I found existing the other day in Central Africa. The native traveller rode on a pony or in a bullock cart, or wended his way on foot, and the journey took as many months as it now takes days. So insecure were the roads, so abounding in peril from man and beast, that travellers were compelled to proceed in armed parties sufficiently numerous to resist attack from predatory bands seeking their prey in the merchandise and effects of the men and the ornaments of the women. During the monsoon rains all movement was interdicted and business suspended. Letters took weeks to reach their destination at heavy cost to the sender, and over enormous areas there were no postal facilities at all, letters being sent by special messenger or entrusted to a casual wayfarer. Shortly before the mutiny a service of horsed stage carriages was put on the Grand Trunk road, but the cost of transit forbade its use except to members of the Government Service and a few other Europeans. The work of irrigation which has since done so much to secure the land against the periodical failure of the rains had but recently been begun. At the ports there were none of the conveniences and facilities which now exist, ships lay out in the stream and loaded and discharged in a slow and inefficient way, their work also being stopped during the monsoon.

The absence of communication severed each province from its neighbour, forced it to depend upon local supply and demand, limiting in this way the work and profit of the agriculturist, reducing him to starvation on the occasion of a local drought, although other provinces might be rejoicing in an abundant harvest, and filling him with despair when in a year of abundance his crop rotted on the fields because there was no purchaser for it. Prices in consequence oscillated in the most extraordinary way from year to year, and were influenced exclusively by local conditions. In practice each province was self-contained, a separate country, with rare and infrequent communication with the others under the same Government. As illustrations, reference may be made to a few well-known instances.

The terrible famine which desolated Orissa in 1866 was due to the impossibility of putting grain into the province either by land or by sea; and it will be understood that where grain cannot be imported into a province neither can it be exported. Such a province is, therefore, in effect an isolated unit. An equally striking illustration is furnished by the course of prices in the eastern division of the Central Provinces adjoining Orissa. In two districts of that division the average price of rice in 1866, the year of the famine, was 15 and 17 seers for the rupee respectively in Raipur and Sambalpur, while in the adjacent district of Bilaspur, the average price was 81 seers for the rupee, that is, one could buy five times more rice for the rupee in that district than in other districts a few miles off. But the trader in Bilaspur was shut off from the others as effectually as if the range of the Himalayas had been interposed. At that period again, Assam was virtually a foreign country, nor did it find itself in communication with the sea until the introduction of British capital and enterprise in opening up the country for the cultivation of tea. As late as 1877, the State of Mysore was desolated by a dreadful famine, against which administrative effort was almost unavailing, owing to the absence of practicable communications during the period when the importation of food was most essential, yet, at that time, the same grains were selling in Western and Central India at a third and a fourth of the price prevailing in Mysore. In Lower Burma there has never been a famine, but Upper Burma, until we swept away the native ruler in 1885, was subject to drought and more or less intense scarcity and famine every third year or so, part of that region being in a dry zone beyond the reach of the monsoon rains. Year after year Lower Burma reaped a harvest of rice in excess of local

needs, but it was impossible to convey the surplus to the market in the upper country in sufficient quantity, with the consequence that as the food could not be got to Upper Burma the starving population made their way down to the food and having entered British territory stayed there. To-day there is a constant and very extensive export of rice from the lower to the upper province.

Such illustrations as I have given of the barriers which shut off the sources of supply from the consumer in adjacent tracts might be multiplied, but it is perhaps unnecessary to do more than to say that the illustrations are typical of the conditions which existed all over the country. Eastern India was shut off from Western India; Western India had no concern with Central or Southern India, and these regions again had no concern with any other part of India. It is hardly an exaggeration to say that each district, almost each sub-division of a district, indeed almost each village was isolated and self-contained. And in addition to the natural barriers which existed, artificial obstacles to intercourse were erected everywhere, internal transit duties being levied at every convenient spot alike in British and native territory by a corrupt and oppressive service of native collectors. India was then hardly if at all removed from the economic conditions which prevail to-day in Central Africa from the Atlantic to the Indian Ocean. That primitive stage of evolution was profoundly modified by the transformed conditions which followed on the disturbance of the Mutiny. The East India Company ceased to exist, and the country was thenceforward administered direct from the Crown. The need for easy and swift internal communications was made clear by the course of military operations, and the railway policy formulated by Lord Dalhousie was pursued, with good effect, with all the energy compatible with the provision of funds from strictly limited sources of supply. The improvement of the few good ports which India possesses was taken in hand, and all the measures adopted for the improvement of communications had for their object to link the whole interior of India by railway with ports where docks, wharves, sheds, and other conveniences enable large vessels easily and rapidly to load and unload, giving the freest play to the course of trade. Internal Customs barriers were swept away, except as regards the pernicious octroi system, which still remains to harass and restrict the industrial and commercial development of the towns of Northern and Central India; the Customs laws and regulations applying to the ports were reformed, the rates of import duty were gradually reduced to a general rate of five per cent., and the barbarous schedule of export duties was wiped out, except as regards rice. This grain, I regret to say, still remains subject to an export duty, because it is erroneously assumed that the Indian trade in rice is a monopoly, and that, therefore, the foreign consumer pays the duty.

While these material improvements and administrative and fiscal reforms were in progress, an enormous stimulus to Indian trade and industry was given by the opening of the Suez Canal in 1870. There can be no doubt that if it had been necessary to continue to send merchandise between India and Europe by the way of the Cape, the pace of progress would have been far slower than it has been, for the outlets for Indian products would have remained restricted by the impossibility of bringing many of them to the European and American markets.

The stimulus thus given to productive and industrial activity had also this important effect, that without excessive difficulty, the people were enabled to bear the annually increasing burden which, about that time, began to be imposed upon them in consequence of the fall in the value of silver. The remittances made by the Government of India on account of the home charges, required each year the extraction of a larger number of rupees from the Indian taxpayer, in order to provide the sum in gold required in England. This increased burden was a grievous misfortune which, but for expansion of trade resulting from the opening of the Canal, could not have been met by the people during the twenty years for which the Government of India waited for the advent of the god from the machine in the shape of international bimetallism, the exchange value of the rupee falling all the time spasmodically and heavily. Let me here pause for a moment to observe that to Sir James Mackay, who occupies the chair at this meeting, is largely due the credit of bringing the Government of India to see that this disastrous state of the currency should not be prolonged, and to change the standard of value from silver to gold. For these reasons I regard the opening of the Suez Canal as an event of the first importance in the economic history of India. From that period, indeed, may be dated the acceleration of

material progress which has marked the last quarter of the 19th century, and is continuing unabated.

We have now reached the point where we may glance rapidly at some of the features of Indian economic conditions which will illustrate the progress that has been made and the changes that have been introduced.

The revenues have increased in the last 25 years from Rs.65 millions to Rs.115 millions, that is, they have nearly doubled. Nor is this the outcome of additional taxation to any appreciable extent, for although new taxes were imposed and existing taxes augmented to meet the exigencies imposed on the State by the fall in the value of silver, the enhanced revenue did not very materially exceed the revenue abandoned in the preceding period in the form of Customs duties, the salt tax, and the income tax. On the whole it may be said that the increased revenue is due, not to any material increase in the incidence of taxation, but to the increase of taxpaying capacity. In these twenty-five years, there has been a surplus in sixteen years, and a deficit only in nine, the aggregate of the surplus largely exceeding the aggregate of the deficits, the excess on the side of the surplus being indeed about Rs.159 millions. These two facts, first, that the enhanced revenues are not to any material extent the product of enhanced taxation; and, second, that the aggregate surplus of these years is so large, would be creditable to any State in the civilised world, and amply demonstrate that Indian financiers have discharged their trust well and honestly in the interests of the country. On the other hand, we are faced by the fact that the public debt has been largely increased, from Rs.79 millions to Rs.117·5 millions in India, and from £59 millions to £130·4 millions in England. But it must be noted that the charge on the taxpayer for the rupee debt is, to-day, slightly less than it was fifteen years ago on a much smaller debt, and although there is a considerable increase in the charge on account of the sterling debt raised in England, it must be borne in mind that of the total Indian debt, sterling and rupee, fully two-thirds are represented by the capital expenditure on railways, which are an asset of increasing value, direct and indirect.

There are now about 27,000 miles of railway open in India, and if we assume that not more than 10 miles of country on either side of a line come by its construction within the influence and reach of external markets, there is an area exceeding half-a-million square miles which has been brought by means of the railways in cheap and easy reach of distant markets, within and without India. The railways play a most important part to-day in Indian finance, the revenue side of the Government accounts containing the large sum of £20,000,000, under the head of railways, being 26 per cent. of the total revenue of the State, while the expenditure side of the accounts presents a slightly smaller sum under the same head. If the railway revenue is excluded from the accounts we shall find the aggregate revenue of the State to amount to less than £57,000,000, a very small sum to be drawn from a population of 230,000,000, and it may be noted that while this is the population of British territory, some of the revenue is obtained from the Native States, so that it may be said that the revenue per head of the population is appreciably less than 5s.

Between 1880 and 1892 the passenger traffic on the railways has increased from 49 millions to nearly 197 millions, and the goods traffic from 10 million tons to 34 million tons; that is, while there were 5,362 passengers and 1,133 tons of goods per open mile of railway in the former year, there were 7,600 passengers and 1,315 tons of goods in the latter year. The rate of increase in traffic is, therefore, considerably greater than the increase in mileage open, and considering that in India great lengths of railway run through tracts of uncultivated and uncultivable land, it must be admitted that the figures give a satisfactory indication of progress.

The imports from abroad have almost doubled, having risen from Rs.621 millions to Rs.1,112 millions. The exports have also increased in about the same proportion, having risen from Rs.760 millions to Rs.1,390 millions.

The deposits in the Savings Banks have risen from Rs.29·3 millions to Rs.107 millions.

The deposits in the Exchange Banks have risen from Rs.40 millions to Rs.118 millions.

The deposits in the three Presidency Banks (excluding the balances of the State) have risen from Rs.91 millions to Rs.279 millions.

The notes in circulation have increased in value from Rs.134 millions to Rs.375 millions.

The number of letters sent through the Post-office has risen from 128 millions to 259 millions. The value of money orders issued has risen from Rs.47 millions to Rs.276 millions.

The cotton manufacturing industry is about four times as extensive as it was in 1880, and the 201 mills in existence, with their 5,164,360

spindles and 43,676 looms, produced last year 576 million pounds of yarn, and close on 123 million pounds of woven goods, giving employment to 178,000 persons.

The smaller industry of the manufacture of jute gave employment in 1880 to 34,444 persons, and to-day to 118,000.

In 1880 the output of coal was about one million tons; last year it approximated to $7\frac{1}{2}$ million tons.

The paid-up capital of the joint stock companies registered in India amounted last year to Rs.$382\frac{1}{2}$ millions.

It is unnecessary to go further into these details of progress, but it may be taken that in every branch and section of trade and industry the indications of progress are unmistakeable, not very rapid but steady and sure, and well marked in every direction—save one, to which I shall presently refer.

So far I have sketched a picture full of light and in agreeable colours; but it is necessary now to qualify the impressions you may have been led by my remarks to form regarding the present conditions in India. In the first place, let me remind you that, as I pointed out in my opening remarks, the advances made have been from what may almost be styled a rudimentary stage. Consequently a glance backward must needs take into view an evolution which is comprehensive and, by comparison with the past, of enormous dimensions. We should, however, be deceiving ourselves if we adopted that past as our standard of comparison. We must not be content with that, and I ask you to take a more useful and effective standard of comparison, and estimate the actual economic condition of India by reference to the conditions which now exist in any other part of the civilised world.

Adopting this test, we shall find that, even after taking the fullest account of all the progress that has certainly been made, India remains in a very elementary condition compared with even the poorest of European countries. The foreign trade of the country, though amounting to an absolutely large sum—£161 millions sterling—is absurdly small for a population of 294 millions. The railway mileage is equally quite inadequate for an area of $1\frac{3}{4}$ million square miles, or rather would be so considered for any equal area in a civilised State; so is the number of railway passengers and the tonnage of goods carried on the lines, and the undeveloped condition of the country is illustrated by the fact that much more than half the merchandise carried on the railways goes to and from the seaports, local traffic being relatively insignificant, and that the bulk of the trade is limited to four or five large lines.

In the matter of coal and of cotton manufactures, the output and the consumption are still extremely limited. So are the deposits in the banks, and though there is a vast store of money in India, it is so scattered in the hands of very small hoarders as to be useless for commercial and industrial purposes. In every direction to which we may turn attention, we are compelled to recognise that India stands so far below the producing and consuming level of any Western country, that the statistics of production and consumption must be multiplied tenfold, in many cases twenty times, even fifty times, before they can be taken as presenting a favourable comparison with other countries, having regard to area, population, and capacity of development.

India, indeed, still remains an agricultural country, two-thirds of whose inhabitants are dependent directly upon the land, and consequently upon the seasons. The great mass of the people are occupiers of extremely small holdings, imperfectly cultivated by reason of their poverty, and landless labourers, living in conditions so far below the standard of this country that it is difficult to make you realise the difference. If I say that the wage-earner in India, the worker, the artisan, not merely the unskilled labourer, lives in a condition compared with which that of a workhouse inmate here is unimaginable luxury, you may perhaps have some conception of the state of the case. There are many millions of agricultural labourers in India whose wage is two annas a day, say about one shilling a week; men whose garments are limited to an unclean rag round their loins and another round their heads, whose miserable huts possess not even the rough rope-strung frame which in India does duty for a bedstead, who eat an insufficient meal from an earthenware platter or a large dry leaf, who are unconscious of luxuries, and happy if they can get a full meal of the coarse, inferior grains which are their staple food. These unfortunate wretches, some thirty odd millions of them, male and female, are the people who first feel the pinch of hunger in an adverse season. Their occupation ceases the moment agricultural operations are suspended until the return of the rains; they are the first to come on the relief works when drought is declared, and they are the last to leave them.

But leaving these, though they constitute more

than a tenth of the population, let us go to a much higher grade in the social scale. The landless labourer lives in squalid misery—or what we must consider to be squalid and abject misery—because he cannot help himself, he can do no better. But when we go to the social strata nearer the top than the bottom, we find a standard of living, even amongst the well-to-do, which is lower than that of the lower strata of our own population. In all countries the great middle-class are the employers of labour, affording to the working and labouring classes the means of decent subsistence, and they are themselves large consumers of necessaries and luxuries. We know the standard of comfort, of luxurious comfort, which prevails here with the prosperous tradesman. Let us see what is the standard with the prosperous tradesman in India. You will find that he lives above his shop in a room which is a sitting-room, dining-room, and bedroom, though it contains neither chairs, nor table, nor bed. A cloth is spread over the floor, on which the owner sits, reclining against bolsters ranged along the wall. His effects and clothes are contained in a box, and that is about the only piece of furniture he needs. His meals are served on a brass platter placed on the floor, whence he eats with his fingers, and he sleeps on the same floor wrapped in a sheet or blanket. Soap is rejected by him for caste reasons, though he is cleanly in person; all our apparatus for ablutions and dressing are unknown to him; he uses the same brass vessel for washing his face and for drinking; he wipes himself dry with a cloth which is also a garment, he has neither glass nor crockery, nor books, nor decorations, nothing whatever of the things that make life worth living to us, none of the things that we consider to be indispensable. He drinks no wine or spirits, no tea or coffee, nothing but water or milk; he eats no meat, and his only luxury is some very primitive form of confectionery. His style of living, in short, is simplicity itself, a most commendable thing, perhaps, from the point of view of the philosopher, but if the movement and progress of the modern world are determined by the desire for the attainment of increasing personal comfort, and if the Indian middle-class do not possess that desire, it is easy to understand that there is a very limited field indeed for the development of such industries as those which cause the factories and workshops of the Western world to hum with active motion. In this absence of a demand for a higher standard of living is to be found the principal reason for the restriction of Indian industrial life and the limitations of internal and external trade. Where there is no demand there will evidently be no supply, goods will not be imported from abroad, nor will they be made locally, for people who do not want them even when they can afford to buy them.

It is frequently said that India can manufacture almost everything that is required in the country, and that it is a reproach to the enterprise and intelligence of the moneyed classes in India that so much is imported that might be made locally. The statement that much that is imported might be made locally is true enough, but it contains only half the proposition; for a manufacturer looking round for the best outlets for his capital and enterprise is concerned quite as much with capacity for consumption as with capacity for production. A man will not expend capital and labour in producing anything unless he is reasonably confident that he can sell it at a fair profit, and the Indian market is much too narrow to induce him to put his money in most of the enterprises which officials and others are apt to thrust upon his attention. Nor is the market wide enough to induce the European capitalist to come upon the scene. The manufacturer in Europe has the whole world for a market, India forming but a part of it. If he were to lose his Indian market entirely or partially, he would lose no more than a portion of his profit; his capital would remain intact, and perhaps he might in other directions obtain compensation for the loss of his Indian profits. But if he started operations in India he would be restricted to the Indian market—a very limited one as we have seen—and would risk, with the contraction or loss of that market, not merely his profits but his capital. I say that he would be restricted to the Indian market because in most cases the goods for which there is a demand in India are also goods which are made and for which there is a demand in other parts of the world, and a manufacturer in India could not reasonably expect to compete successfully with manufacturers elsewhere more favourably situated to meet demands in other countries, and equipped on a scale adequate to meet such demands at the minimum cost. These remarks apply also to the Indian manufacturer, and it should be recognised that it would not be wise, in existing conditions, for anybody to risk his money in industrial enterprises in India except in the relatively few cases in which the articles

made are of such a character that their consumption is mainly or very largely limited to India and the neighbouring regions, or for which there are special and peculiar manufacturing facilities in India with a large external demand in countries where competition with European or American manufacture is easy. To illustrate my meaning let me take the case of the manufacture of glass. Writer after writer, commissioned by Government, has pointed out that good glass may be made in India, and occasionally well-meant effort has been expended in acting upon the hint. It is true that all the necessary requirements of glass-making exist in India, but when the glass has been made what is to be done with it? There are perhaps fifty million houses at least in India, and that number of houses in the Western world would create an enormous demand for glass for windows. But the demand for window-glass in India is of the smallest dimensions, because it is doubtful whether one house in a thousand in India (most of them mud or straw hovels) has a glazed window. If the maker in India exported his sheets of glass it would be necessary to send them to European countries where they would compete with European manufacture, and, of course, unsuccessfully. So with table-glass in an even greater degree, for the natives of India, with very rare exceptions, use earthenware or metal vessels.

Again, quite recently, a wealthy Parsi gentleman in Bombay was desirous of starting the manufacture of iron and steel. He had all the capital needed, and the materials and other conditions were such as to promise complete success. But inquiry by skilled persons showed that outside the requirements of the Government and the railways, the demand for iron and steel was not enough to keep even one large works constantly going, and as competition with imported iron was not possible unless the manufacture was conducted on a very extensive scale, the proposal was reluctantly abandoned.

[Here I take the occasion to express the regret with which, in common with all his friends, I learnt of Mr. Tata's death a few days ago. He was the highest type of a good citizen and an upright man.]

Similar remarks apply to an extremely large number of articles of all descriptions, and one is forced to the conclusion that it is useless to suggest the extension of industrial operations in India until the social condition of the people is profoundly modified, and their standard of living greatly elevated.

It may seem that unnecessary stress is being laid upon these points, but a difference in the standard of living implies a really enormous difference in the character and dimensions of trade and industry. To illustrate my proposition I shall take a concrete case in Burma. That province imports merchandise from foreign countries in the ratio of about 7s. 6d. per head of the population, while the imports of the other Indian provinces are no more than 3s. 4d. per head, the imports of Burma being well over double those of the rest of India per head; they are really about three times as large, for Burma, in addition to direct imports from foreign countries, takes large supplies of foreign goods from Calcutta. Now, Burma is an agricultural country in quite as great a degree as the other provinces of the Indian Empire, and it possesses no industries of any consequence other than what is to be found in the mills which husk and prepare rice for export. For practical purposes Burma is essentially agricultural, and there is nothing in administrative or other conditions to differentiate this province from others, with two exceptions, but these are of the first importance. In the first place, the Burmans are Buddhists, who are not debarred by laws of caste from the use of any article that pleases them, as are the Hindus. In the second place, it pleases them to use a great many things that Hindus might use without defilement. In short, the standard of living amongst the Burmese, from the highest to the lowest, is much higher than it is in India. I add a third consideration, which is that illiteracy is far less common in Burma than in India. In Burma, one-fifth of the population can read and write because there is, in its way, an excellent system of instruction carried on in the Buddhist monasteries; in India, amongst the Hindus, only one-twentieth of the people can read and write, and amongst the Muhammadans only one-twenty-fifth. An even still more important consideration is that the Buddhist women in Burma also receive some education, are as free as women in this Western world of ours, and take quite as large a part in social and business life—very good men of business too are the Burmese women. These social conditions are in striking contrast with those existing in India, at least outside of Western India where the small community of the Parsis have set an example to the surrounding people about as good as we could set our-

selves. They have thrown off the restraints which, for their own safety and comfort, they imposed on themselves when they first came, twelve hundred years ago, to dwell amidst Hindus. They have emancipated and educated their women with the best results, and there can be no doubt that amongst the Parsis, as amongst the Buddhists of Burma, the standard of living generally is far higher than amongst the surrounding Hindu and Muhammadan population.

I have the conviction that in both cases this result is largely due to the greater diffusion of education amongst both sexes, and to a due share in the conduct of social and business life being taken by the women. I have told you that in Burma the consumption of imported goods is about three times what it is in India, and you can understand what a remarkable development is implied in the trebling of the value of Indian trade, now, as I have before said, amounting to 161 millions sterling. If the importations of cotton goods, now amounting to some 22 millions sterling, were increased threefold, Lancashire would be happy. Such expansions of trade are necessarily followed by expansions of local production, and the rise in the standard of living would create the local outlet for manufactures which would warrant the investment of large capital. It is not too sanguine to point to such prospects. I do not say they will be speedily realised, for my experience is that, in India, things move slowly, though they do move. For reasons that the passing of time precludes us from discussing, nothing like the pace of the movement in Japan can be expected in India, nor is it perhaps desirable; but the present pace may easily be accelerated without imparting to it an air of unseemly and exhausting hurry. The very first necessity, to my mind, is the diffusion of primary education, and in this matter it is regrettable to have to say that the Government have been remiss. They have given much attention to secondary and higher education, but the teaching of the masses has been reprehensibly neglected. That it is a difficult question is true, but our position in India requires that we should face and solve difficult questions, not evade them because of their difficulty, which in this case lies chiefly in the magnitude of the thing,—at least so far as the education of males is concerned. This work ought really to be taken up in earnest and without further delay.

With it, too, should be taken up the question of elementary technical education for the training of artisans and mechanics. At present, it may be said that, outside the railway workshops, and those of the largest factories, no such training schools exist, and in consequence, although the natives have as much capacity as any other people for working in wood and the metals, it is not easy to find a carpenter or blacksmith who can turn out a decent piece of work.

The elimination of caste prejudices is not a matter in which the State can intervene. This must be left to the people themselves, and those who are aware of the elasticity of caste rules, and even of what are assumed to be religious doctrines, are quite content to leave these matters to the people themselves, satisfied that when a caste rule begins to conflict with new conditions as they arise, the rule will in due course be wiped out. I remember that on my first visit to Madras, nearly thirty years ago, a native gentleman, in high official position, called on me, wearing native slippers which he left at the door when he entered the room. He told me, in answer to a remark, that being an orthodox Brahmin, he could not wear shoes of European pattern without infringing caste rules. Some twenty years later he came up to Calcutta as an Additional Member of the Viceroy's Council, and came to see me—not in bare feet and native slippers this time, but well shod in European shoes and socks of elegant appearance. If an old gentleman of the old school was able to conform to new opinions, and put a caste rule quietly out of sight when it became inconvenient, the younger generation of the new school are not less ready to do the same thing. Such action is also taken when desirable by bodies of the people as well as by individuals or small sections. An instance occurs to me in the case of the construction of the Calcutta waterworks some forty years ago. Objection was raised to these because they involved the payment of a water-rate, and it was urged that as Hindu caste rules forbade the use of the water conveyed through pipes and forced into them by pumps, the works should not be constructed. The works, however, were not interrupted, and when on their completion the Hindus found that the rates must be paid though they were free not to use the water, they discovered that, according to the solemn dictum of the Pandits, there was no infraction of caste in drinking the water of the Ganges even when pumped through iron pipes. The caste question has not since been raised in any Indian municipality in

connection with waterworks. There have been, in fact, so many illustrations of such disregard of caste rules when they are found to be objectionable or inappropriate that we may safely leave the dissolution of these old bonds to the solvents applied by the ordinary conditions of life and work at the present day. The process will not be rapid, but it will be sure, and it will be hastened as the people receive the education they ought to receive, especially if the women share in the education.

While I lay the greatest stress upon these essential factors in the Indian economic problem, there are others which merit close and constant attention. First amongst these is the condition of the agriculturist. Divided up as the land is into minute holdings, averaging, perhaps, less than five acres, dependent upon the season for a crop or no crop at all, the agriculturist is in a precarious position. It is imputed to him, as an indication of original sin, that he is always in debt to the moneylender, and that he is extravagant in outlay over marriage feasts. But in truth the man is not so much to blame as the system for these offences, if they can be so regarded. He is in debt because he is very poor and cannot be otherwise on the small holding he cultivates even if it always were to give him a full crop, which unfortunately it does not. His poverty makes him borrow money for the purchase of seed or plough-bullocks when famine or pestilence has killed his beasts, and if he does make a show when his daughter is married, let us not forget that it is a fortunate thing for a man in India to secure an eligible husband for a daughter, and the occasion is one of real rejoicing. We do not now permit them to kill off their female infants, and we need not point the finger of scorn at them because a man spends some money when he secures a husband for a girl who would be shamed if she were not married. The occasion, moreover, does not come every day, and the effect of such extravagance has been greatly exaggerated by persons who find it easier to suggest such incidents as the cause of agricultural indebtedness than to go to the root of the matter and see whether administrative action or inaction has any share in the depression of the agriculturist, while in every other direction there has been marked advance.

I do not wish to enter upon any controversial topics, and decline to criticise the Government of India from the point of view of those who make it their business to formulate all sorts of absurd and untenable charges against a Government whose integrity of purpose, whose desire for the good of the people, cannot be candidly impeached. But while this must be said, it is also possible to express a doubt whether the agrarian policy of the Government is the best, at the present day. I venture to think that it is no complete defence of that policy to compare the assessment on the land to-day with the assessment in the days of our predecessors. It does not follow that we are very moderate in our demands on the land because we do not take so much as was squeezed from the cultivators by rulers and governors who were highly esteemed if they did a man the favour of allowing him to live. We ought to arrange to let him live and thrive, not take from him the competition rent of a private landlord.

It is doubtful whether the efforts now being made to take the cultivator out of the hands of the moneylender will have much effect, or, even if they have the fullest effect, that they will materially improve the cultivator's position, until a larger share of the produce of the soil is left in his hands, and he is protected against enhanced assessment by Government officials, and against enhanced rents by private landlords. This, as I have said, is much the most important of Indian industries, more important than all the rest put together, and it should receive from the State more discerning attention than, I am afraid, has as yet been given to it. We must appreciate to the full all that the State is doing, or proposing to do, in the provision of irrigation (as to which I may note that upwards of 30 million acres are now annually irrigated)—in the provision of advances for improvements, in lessons on reformed methods of cultivation, in the introduction of new plants and improved implements, but—important as these are, especially the development of irrigation—I have little doubt that the reduction of the land revenue by 25 or 30 per cent., if the reduction is secured to the profit of the cultivator, would be of far more value in the improvement of the class who constitute the bulk of the population and who contribute most largely to the finances of the State.

A charge frequently brought against the Government of India is the expenditure of a large sum of money in England every year. The sum drawn by the Secretary of State for India, which sum must be met by the Indian taxpayer, is treated as "tribute," and it is represented that the remittance

f this sum—now about 18½ millions sterling nnually—is a cruel drain on the resources of ndia. This kind of talk is merely extravagant ionsense. A proportion of this money is paid or value received in materials for the con- truction of railways, telegraphs, and other ublic works, and for stores of all kinds equired for the maintenance of the civil and nilitary administration. Of the rest, some epresents interest on debt incurred for railway onstruction, and the remainder is applied to ayments to officials on leave or retired. No loubt, if India was able to raise money in- ernally for capital expenditure, and was not ubject to a European administration, if her fficials spent their lives in the country, the harges would be largely reduced, and the xcess of exports over imports, which is now a egular and prominent feature of Indian trade, vould disappear. But in respect to that portion f the charges which represents payment for vhich there is no direct equivalent in ma- erials supplied, it should be recognised that he equivalent has been or is being given in services rendered, services which have made ind make it possible for India to carry on the ndustrial pursuits of life in peace and security, ind to make the progress which I have outlined n this paper. Without the home charges ndia would not have been able to make any rogress at all, for she would not have had ither the capital or the trained intelligence vhich has been applied in the service of the ountry, or the army which has guarded ts frontiers. India is a debtor country— ne of the many debtor countries of the world vhich are obliged to draw upon foreign re- ources in capital and labour. For these she nust pay, but she obtains good value for the noney. At the same time the greatest care should be exercised to restrict the growth of hese charges, for the same reason that it is etter to raise an internal loan than to resort o the foreign moneylender. The unremitting ittention of the Government should be given o this point to prevent the undue increase of vhat after all is certainly a burden in the xpenditure abroad of taxes raised in India.

Another matter to which careful attention is ieeded is the control of expenditure on the irmy. Already this amounts to the whole of he land revenue, one-fourth of the whole evenue, and continued pressure is brought to ear for its increase in order to perfect the nachine. Reduction in these charges cannot e urged in view of the actual necessities of he position, but it should be remembered that expenditure on defence must bear a reasonable proportion to the value of the property to be defended, and that it is not the part of wisdom to endeavour to be prepared against any possible eventuality, however remote, at the cost of impoverishing the people who are to be defended.

We are confronted in Europe by many examples of the crushing burden of militarism on the taxpayer of even wealthy countries, and, as we have seen, India is a poor country, an extremely poor country judged by any European standard, needing that her resources should be carefully husbanded and made the most of by a thrifty and prudent administration. In India, sooner than in any country in the world, are the works of the reckless and short-sighted financier likely to do irreparable evil. We want there essentially conservative finance, a system of taxation alike simple and good (as good as any system of taxation can be expected to be); the maintenance of taxation at a moderate level; the removal of customs duties, which, in a poor and backward country, operate most harmfully in restriction of trade and consumption; the removal of octroi duties, which interfere with urban development, and consequently with the development of the industries we are all so anxious to see established; and the limitation of expenditure which is not directly reproductive.

I have only one further suggestion to make. At the present moment it is stated that a new department is in contemplation, specially constituted to deal with the commercial and economic problems which present themselves for solution, but are mostly quietly set on one side by the Government of India. This seems a useful measure, but the value of the department will be greatly impaired unless it has the power to formulate and declare a policy without first submitting it to the local governments for criticism and opinion. Under the existing system, this procedure, which is considered essential, merely entails waste of time in references to local officials, excellent administrators but utterly unqualified by training, disposition, or experience, to form a useful opinion on such subjects as those I have been discussing in this paper. I have so frequently seen promising reforms mutilated and deformed, or put aside entirely, because local ignorance and prejudice were arrayed against any suggestions from external sources, that I should be sorry indeed to see the new department brought

under the same restrictions and difficulties. The department should formulate its policy for general application, and should then proceed to confer with the local authorities—not by correspondence but personally—as to the most effective methods of putting the policy into local operation.

I have now shown you—imperfectly, no doubt, but as clearly as I could without leading you into a wilderness of detail and being unduly tiresome—that India has made enormous progress in recent years, but that her economic condition still leaves to-day very much to be desired. I have indicated some of the reasons for that relatively slow progress, and the directions in which it is possible to aid and hasten it. Even such as she is to-day, however, India is a possession of high value to the Empire, and with a continuance of the excellent Government which guides her destinies, no limit can be assigned to her development, and she will more and more be regarded as the most splendid jewel in the British Crown.

DISCUSSION.

The CHAIRMAN, in opening the discussion, said that although Mr. O'Conor was not satisfied with the position in which India found herself both commercially and economically, still his paper recorded a progress during the past fifty years which, to his ears, sounded almost like a fairy tale. He thought the British nation had good reason to be proud of its achievements in India. Undoubtedly the standard of living there for the large mass of the population was extremely low, and it was also true that as that standard improved—as it would assuredly—the trade both with and in that country would vastly develop. Therefore, from a commercial standpoint, as the author had pointed out, it was most desirable to see the condition of the people improve. Mr. O'Conor's remarks on the advantages which India had derived from the abolition of the transit dues appeared to be extremely pertinent. No doubt those dues were a curse to the country, just as they were now the curse of trade in China, and it would be a great advantage if the whole of the *octroi* system which still prevailed in some parts of northern India could be abolished. He entirely agreed with Mr. O'Conor's view that it would be desirable to do away with the import duties on goods going into India, and he agreed still more with him when he said that the export duty on rice ought undoubtedly to be abolished. Although Mr. O'Conor did not take a particularly cheerful view of the condition of the people of India, it was a satisfaction to find that if the indications showed that progress in trade was not very rapid, it was, at any-rate, steady and sure. Those words, coming from a man like Mr. O'Conor, than whom it might be saf said there was probably no man in the world w had a better knowledge of the economic and co mercial position of India, were extremely reassurin

Sir WILLIAM LEE-WARNER, K.C.S.I., sa there was one sentence at the beginning of the pa which he felt bound to question to a certain exte namely, "On the whole the economic progress India is the work of the last forty years." It c pended on what was called "progress." If a pers were suffering from a mortal disease, and someo checked and cured it, and afterwards built that pers up to a state of convalescence, he maintained th the progress began from the hour when the dise itself was checked. That had been the work of r years, and not of forty years. What India had be suffering from was the utter disorder which, on t breaking up of the Mogul Empire, totally paralys and wrecked the whole of the village industries. T first thing to be done was to give the country pea and after peace, order; and something more th order, because India consisted of two parts—Briti territory and the Native States; and the latter mu be brought under a political system, so that our i fluence over them could tend to the abolition of t transit duties to which the Chairman had referre He thought it an injustice to the great men who rul and put India in order, to hold that the econom progress of India had been exclusively the result the last forty years. Mr. O'Conor had said that l scented three great dangers. One referred to t land revenue, which he considered was excessive. N doubt most people were agreed that in many di tricts a reduction of the land revenue would b desirable, except in Bengal, where some thoug it was too low. But that particular point h been thought about, and by no one more ab expressed than by the late Lord Salisbury whe he said, "If India is to be bled, it is better th it should be bled where there is superfluity and n paucity of blood." Everyone present was being bl by the tax-gatherer of England. Lord Salisbury ha said that it was better to treat the land revenue as th treated the rest of the taxation. Let there be a pr portion between that paid by the agriculturist an that paid by the non-agriculturist. It was to b hoped that, in course of time, as India progressed, would be possible to reduce the burden on the lan The next great danger was that of military expend ture. In all parts of the world people were afraid unnecessary military expenditure. It was difficult t form an opinion in the concrete, because none them were aware of all the dangers which it wa hoped were known to the governing authoritie Assuming that the Government of India were almo as wise as their neighbours in judging of danger they had one reason for economy which the Britis Government at home had not, namely, that th Government of India were constantly investing mone in reproductive expenditure, in canals, railroads, &c

erefore, they had a greater interest in economy; d owing to the absence of a representative system of vernment, they did not have to conciliate parties, or e British public, or the public of the country itself, giving them what they desired at the expense of e taxpayer. Coming to the third danger, he was aid that he must part company with Mr. O'Conor, 10 scented in the air danger from consulting the cal governments. He (Sir W. Lee-Warner), on e contrary, scented in the air the ever-increasing nger of over-centralisation. What was wanted is that the Government of India should foster terprise everywhere, and allow commercial men, th their vast abilities, to work out – he would not say eir salvation—but their own interests in their own ay. One great thing was to let the local governments velop on their own lines. When the Government India saw something good, the Victoria Institute, r instance, started in Bombay, for technical educa-on, or a first-rate school for young chiefs, let it ot say, "We will starve the local college and ive one great central institution for the whole the Empire." Let the Government of India arn why these local institutions flourish, and say the other Governments, "This is the secret of ccess; go and do thou likewise:" he felt con-nced that the one hope of India was for the Govern-ent not to undertake other people's work and read out in too many directions. Its credit was of tal consequence; and the tendency of spreading out as to waste money. Let them look around if they anted to see the monuments of success of local evelopment and ask themselves why Cawnpore has rown. Fifty years ago Karachi was a wretched little llage containing a few Baluchis and Arabs. Look what Bombay was and what it is now! Then let hem ask themselves, Did these people owe their ccess first entirely to the officials? No. It was e private enterprise of those gentlemen of com-mercial and business habits who had done so much r India. Again, Did it owe the residue to the entral Government or to the Local Government? He honestly believed the answer would be, To the Local Government.

Mr. J. D. Rees, C.I.E., said there was one omparison in the paper which was fallacious, and hich, he thought, vitiated the author's conclusions. They were asked to compare India with reference to s industrial progress, and in other respects, with hat the author called civilised countries, by which e presumed was meant Western civilised countries. He contended that that was not the proper standard; ut that one Oriental country must be compared vith another. It was true that India was under British rule, and that it was our duty to elevate it as nuch as possible; but it was no part of our duty to ndeavour to make it an imitation of a Western ountry. Japan was very much in the air just now; ut all the progress and change in Japan came from vithin; what they had accepted,—and not from any pressure from without. They had been told in the paper that the native of India both bathed and drank out of the same brass vessel. But that was not the case. He did not wash his face in the vessel, nor did he drink from it; he poured the water in the one case over his face, and in the other over his mouth. There was no objection to his using one vessel instead of two; in fact, he saved by doing so. If the standard of the native's wants were low, he should not, there-fore, necessarily be put down as uncivilised. When Mr. O'Conor spoke of the poor condition of the natives of India he forgot that during the height of the great famine a smaller proportion of the people was in receipt of relief than is the case in this rich country in a normal year. That, he thought, was a sign that, on the whole, the condition of the people was not such as the author had endeavoured to show; but that they were a civilised people, and did not require a Poor-law—to be more or less ill-admin-istered! Mr. O'Conor had referred to the non-use of glass. But speaking for himself he considered the natives the richer for not wanting glass in their windows. With regard to the fall in exchange, he agreed with the author in thinking that the adoption of a fixed exchange was a good thing for India; but it must be remembered that it was an arguable point that while it might be a good thing for the trade of India and for foreigners, it might be a dis-advantage to the producers in India to receive a smaller number of rupees for their produce. He could not quite agree with Mr. O'Conor when he said that the extra revenue was not due to extra taxation; but perhaps after his criticism the author might be induced to slightly modify that statement. Mr. O'Conor had not grappled with the question of the countervailing cotton duties for which he (Mr. Rees), as a member of the Viceregal Legislative Council had voted, because he believed that India, as a part of the Empire, must necessarily accept a policy of Free Trade, which was the keystone of the Imperial arch. It would be interesting to know how this position could be defended in the event of a change in our fiscal policy. He was glad to find Mr. O'Conor had done justice to the caste question. He had not stated, as most speakers in this country did, that caste was an obstacle to change—on the contrary, he handsomely admitted that it adapted itself to every necessary change, and was, in fact, the cement that kept the social scheme to-gether in India, without really interfering with any necessary development. With regard to the question of expenditure, no one liked to mention concrete cases in which it might be diminished, but he believed there were many such. For instance, it would be absolutely impossible, in a country possessing anything like representative institutions for a person to get £100 a year pension for life for one year's work in a country. There were, he contended, re-spects in which the expenditure might be diminished, and he regretted that Mr. O'Conor had not gone more fully into that question.

Sir M. M. Bhownaggree, K.C.I.E., M.P., said that no one who knew him could accuse him of under-rating the blessings which had been conferred on India by British rule, but he felt bound to differ from Mr. Rees when he said that we should be content to compare India with Oriental States however backward. After two centuries of British rule, and after the introduction of the Western system of education and methods of administration, one might almost question the justification of the British being in India at all if such a comparison alone were admitted. The author of the paper had fairly dealt with his subject on the whole and palliated nothing. He recognised fully the causes that were at present holding India from the onward path of prosperity which all would like her to tread, and he at the same time claimed for British rule that it had secured peace in the country by which her material and moral progress had vastly increased. With both those propositions he was in perfect accord. He could not, however, entirely agree with Mr. O'Conor when he put down the absence of industrial enterprises to certain causes. Mr. O'Conor, for instance, had told them that the people did not use glass, and that they had neither ornaments nor pictures in their houses ; in short, he argued that there was hardly any large industry which could flourish in India, simply because the wants of the people were very greatly restricted. This was a mistaken idea, a mere excuse, which if allowed to pass unchallenged might do harm. As against Mr. O'Conor's glass, he would put brass or copper. Two hundred and ninety-six millions of people, poor and rich, were bound—it was a religious obligation upon many of them—to use metal chattels and vessels for taking their meals in. He trusted the day was far off when the people of India would become accustomed to drinking copious drafts of wine from glasses ; but so long as the masses had to use brass and metal vessels he did not see that there was any reason why large maunfactories for making brass and metal vessels should not flourish. They were not made there so much now as people thought, and the native industry was being invaded. It might not be known to those present, but it was a fact that a very large proportion of the metal vessels used in India came from Germany. He had in his own study a number of copper or German-silver vessels which were marked at the bottom "Best—best German silver: made in Austria." The German manufacturer gave so much credit to the people of India for economic patriotism that he was afraid that if they knew those articles were manufactured in Germany they might not perhaps use them. Therefore he stamped on them this legend in the form of a rupee with a figure of His Majesty in the middle. He maintained that if proper industrial guidance were given to the educated people of India this sort of quiet invasion on many of her old crafts would not occur. One of the most valuable passages in Mr. O'Conor's paper was that pointing out the necessity the Government undertaking technical instruction u a large scale. So long as there was in the people India no knowledge of economic subjects—and th was very little at present—so long as they did know how their country was drained by fore manufacturers, so long as they were not taught there was a better use for education than the atta ment of purely literary scholarship, so long wo the people of India remain backward. He trust that the outcome of these frequent papers a discussions would be that the Government of In would take some action in promoting technical a industrial education which had been so seriou neglected. There was no want of intelligence the part of the people. All they wanted w guidance and encouragement. They did not kn how to get hold of their raw produce and work upon it. Until some means were found enable them to do that no appreciable stri would be made in the industrial development the country.

Sir Patrick Playfair, C.I.E., said:—It gives much pleasure to add my humble token of apprec tion of Mr. O'Conor's paper, although it is somew dismal in tone. It affords me additional pleasure th this paper has been read under the auspices of one w has himself done so much to advance the industri and commerce of India. By the active and intellige part our Chairman took in supporting the curren policy, with which Lord Lansdowne's name is eminently associated, he helped to give a new lea of life to Indian industries, by giving the capital e ployed a reputable value. At least, such is my e perience, and I speak through the heart from t pocket. A very great hindrance indeed, if it is n at present the chief hindrance to the development the industrial enterprise of India, both in textile a agricultural pursuits, is the want of labour. T same cry comes from Bombay and Cawnpore Cott spinners, from Bengal coal raisers and jute spinne and for a long time has been heard from the plant of Assam. It was an anomaly when looms we silent in Calcutta for want of weavers. that a f hundred miles distant famine-stricken weavers we obtaining relief from the Government. Looms to-day out of work in Calcutta because weavers a wanted. Wages are liberal, and, in some instances, a extravagant, and scarcity of labour cannot be att buted to want of income. This is a remarkable c cumstance in view of Mr. O'Conor's description poverty among the masses. The fact is, there is mu difficulty in conveying to the minds of the people the interior an idea of the good wages that await the in other districts. In most cases they are ignora of the industry. I give you an illustration the circumstance. Some labourers in the Unit Provinces when told that high wages were obtainab in the coal fields of Bengal, asked what coal was, a

when given the homely definition of a stone got from the earth that burned, and by which their food might be cooked, they laughed, and, as a free translation of their Hindustani reply, told the would-be employer to "Tell that to the Marines; cow-dung and wood were the only two articles of fuel." The Labour Laws in connection with Assam have not answered the purpose intended. I am no advocate of Government interference with private enterprise, but I think the establishment of a Labour Bureau by the State, with an earnest desire that the industries of India should, for the sake of the people and the country, be well supported, might do a good deal in obtaining supplies of labour. Government might be able to interest zemindars in emigration, for, like Shakespeare's definition of the quality of mercy, migration is twice blessed. It blesseth him who gives and him who takes. The native seldom separates himself permanently from home and soil. He remits part of his earnings to his home, and looks forward eventually to returning thither. I have often thought that were the zemindars far-seeing and worldly-wise they would capture some of the wages expended in the industrial pursuits of India, through land rent realisable from that portion of the family remaining at home, and from the emigrants on their return. I have said I do not care about Government interference. If investments are sound and realisable, there will be plenty of money to undertake the development of the country by private enterprise. I have always believed much more in the development of Indian industries through Grocers-hall and Threadneedle-street, than through the intervention of the Palace of Westminster. In saying so much I do not forget that the Government factories at Cawnpore, Alipur, and Cossipore enabled India to send saddles, boots, tents, harness, uniforms, shell, and ammunition as supplies for the South Africa War, and with the fodder and horseflesh also exported, did great service to the Empire. From some of these industries Government should, in course of time, withdraw. We must feel inclined to shun Westminster since the Budget proposals for an additional import duty on tea were made known. It does seem a great pity that a tax should be imposed to check the consumption at home of a very important and desirable article of produce. It gives other nations, including the neighbouring countries of Afghanistan and Thibet, the excuse to uphold prohibitive tariffs. Continental countries have followed the example of Britain in the import duties levied on tea, and when we hear such loud protestations on behalf of the policy of Empire, and an endeavour, as I believe the Government of India has been endeavouring, to open up further commercial intercourse with its neighbours, this action of the British Government seems contradictory, as in terms of the commercial treaty Thibet and Afghanistan have the right, I understand, to levy a Customs' duty similar to that imposed on tea entering the United Kingdom. I doubt if much tea will cross the Thibetan border with an 8d. duty. I think we have reason to ask the British Government for some relief.

Mr. J. A. BAINES, C.S.I., submitted that so far as Mr. O'Conor had confined himself in his paper to the statistical aspects of the progress of India, he had taken the thoroughly moderate and commonsense view that an experienced and honest treatment of figures naturally suggests. He could not, however, help differing from Mr. O'Conor in his standard of comparison. When he set forth the progress made in India between one date and another he might perhaps also have found the same difference in this country between the latter half of the 18th century and that of the 19th century, or even between the first 40 years and the last of the latter period. On the other hand, when comparing—as one must in estimating the growth in prosperity of a country—not one country with itself at two periods of its own history, but with different countries, either during the same period, or in the corresponding stage of civilisation, one ought to take heed that one was working *pari materia*, and under conditions which were properly comparable. But, as Mr. Rees had pointed out, to compare East and West, in other words, to compare India with the United Kingdom, would not be comparing material which was properly susceptible of comparison. The standard was entirely different, as the primary needs of the one country were totally different from those of the other. He was inclined to think that the proper comparison would have been between Oriental countries, say, India and China,—the two largest aggregates of population under one rule in the civilised world. He used the word "civilised" deliberately; because a great deal had been heard about the advance of civilisation and the advance of material prosperity from our Western standpoint, but it must be remembered that the civilisation of India and China was in its way quite as elaborate and far-reaching as that of Western countries. The one great object in the administration of India was, either by direct Government action, or, at all events, by the protective action of the Government, to allow the Indians to evolve, as they were competent to do, a civilisation of their own on that great basis which they already possessed, and not to impose upon them partially assimilable attributes which are alien to the climate and their scheme of life. There was in the caste system a very fine basis of morality and religion; and whether it expanded fast enough or not the fact remained that were it not for that system Indian society would not be what it is, and would not have survived the shock of all the invasions of different nationalities and religions which it had withstood from time immemorial.

Professor W. J. SIMPSON said he fully agreed with the author that there had been considerable progress in regard to the material side of India. On the other hand, there was one point affecting the industrial

position of India, that Mr. O'Conor had not touched upon, but which had been mentioned by Sir Patrick Playfair, namely, the increasing difficulty in regard to the labour market. He had heard complaints from many merchants of the difficulty in obtaining coolies for the tea gardens, and also the difficulty in procuring workmen for the mills, in fact, for labour generally. Only last year the matter was discussed by the Bombay Chamber of Commerce, and the question arose, What is this due to? The Indian coolie was not, like the native of South Africa was said to be, a lazy individual, but was quite willing to work under normal conditions. So far as he (Prof. Simpson) understood, it was only within the last seven or eight years that the difficulty with regard to the labour question had arisen, and he ventured to think that it was due in great measure to the plague epidemic. Last year no fewer than 800,000 deaths occurred among people belonging to the labouring classes, and this year the numbers would be very little less, for he noticed that during April alone there were nearly 40,000 deaths every week. There were in India 300 millions of inhabitants, but no country could afford to lose one in 300 of its population continuously from one disease. The mortality in the South African War during the whole of the three years did not come up to one week's mortality from plague in India; and if the entire armies of Kuropatkin and Kuroki were destroyed at the present time the mortality would not be equal in magnitude to the deaths from plague in India in the course of six months: but there was no indication that the people of this country were at all aroused by this state of affairs. It was neither the time nor the place to enter into a discussion of the question as to what the Indian Government had or had not done to ameliorate that calamity; but the epidemic had an important bearing on the material condition of India; and no one could say that the enormous mortality from plague was an indication of prosperity.

Mr. ROBERT H. ELLIOT said the first question arising as to the economic condition of any country was: Does capital go freely to it or not? Only quite recently he had met an eminent economist at the Athenæum Club, who had said to him that capital would never go to India so long as there was an artificial system of currency which could be altered at any time at the will of the Government. The next question which arose was: What was the condition of the industries of India? He could speak as to that, as he had been engaged in Indian industries since 1856. One had only to go to Bombay and ask about the mills which had been shut up, or inquire into the condition and prospects of any other Indian industry in order to find that there is a general state of depression, and the economical and industrial condition, and the cause of the existing depression as regards both, have not been touched upon in the paper, and most of the people connected with India did not, for obvious reasons, care to discuss the subject. Whenever he had mooted the question the was silence, and the reason he knew perfectly we namely, those whom he had interrogated addressed, had interests diametrically opposed those of the producers of India, of whom he was or

The CHAIRMAN desired to thank Mr. O'Con not only for his very valuable and interesting pap but for the very interesting discussion which it h evoked. It had been from his point of view m instructive, and it had been a great pleasure to h to preside at the meeting and listen to the remar which had fallen from the speakers. Prof. Simps had drawn attention to the great mortality in In on account of plague. No doubt what that gent man had said was perfectly correct, and it was extremely serious matter; but the question w How could it be stopped? During the last year two it had been stated that it was not so much t plague which had made labour scarce as the chea ness of food. He had been told that the price rice was lower in Calcutta than it had been f twenty years, and that a man could get sufficient fill his stomach by working two or three days inste of having to work the whole week. Whether th statement was correct he was not prepared to sa but he understood it to be the case.

The vote of thanks to Mr. O'Conor was carri unanimously.

Mr. O'CONOR writes:—I must entirely decline accept the view that it is not fair to compare Ind with Western countries, and that a fair comparis would only lie with such a country as China. As indication of the advance that has been made in Indi a comparison with China, or Persia, or Siam, has i uses, and that comparison can be said to have be made by me. I stated at considerable length t difference between the India of to-day and the Ind of the pre-Mutiny period, and we may take it th the comparison holds equally good for the countri mentioned, which may be said to be to-day in economic condition as little advanced as was that India fifty years ago. But this is only part of th inquiry. We have not only to measure the progre made from the starting point by comparing prese conditions with pre-existing conditions; we have al to measure the present conditions by the test modern efficiency, and when we do this we mu necessarily take another standard. As a matter history, it is interesting to note the difference betwe a modern rifle and the musquetoon of Cromwelli days, but if we wish to test the practical efficiency our rifle we take an entirely different standard comparison, and judge of the article by similar articl used by modern armies. In the same way, whi pointing to the great progress made since India w in a rudimentary economic condition, I maintain th I am right in pointing out how many more stag must be travelled before India can come near even

ckward Western country. Such a comparison ould be welcomed as a stimulus to activity, and I nfess I see with regret once again that unfortunate ndency of Indian administrators to be satisfied with ow and obsolete standard of comparison with the st, and to resent the setting-up of higher and better odern standards for comparison. I call that tendency fortunate because I believe that it generates a iggish self-complacency fatal to the development active endeavour and, therefore, injurious to the untry we administer.

Sir William Lee-Warner admits that the land venue is probably too high except in Bengal, where is too low. If he had gone a little deeper into this estion he would not have failed, I am sure, to cognise that though the Government revenue from e land in Bengal is low, it allows the zemindar to ke a competition rent from the cultivator, a rent hich is certainly at least as high in proportion as at which is taken in provinces where the Govern- ent assesses the cultivator direct. Whether an duly high rent is taken direct by the Government by the middleman with the sanction of Government es not matter. My argument is that the cultivator ould be protected against excessive enhancements his payments, whether they are made to the State to the middleman created by the State.

I wish the gentlemen who took part in the dis- ssion—to all of whom I am obliged for their urteous reception of my paper—had expressed their ews on the need of much closer and earnest effort in e diffusion of primary education, especially of such lucation as fits a boy to follow with trained in- lligence and acquired skill the calling to which he longs, whether he is an agriculturist or an artisan. erein lies our primary duty to India, and I trust at it may very soon become impossible to say with uth that it is still neglected.

Sir Guilford L. Molesworth, K.C.I.E., rites :—There can be no doubt that India has made reat progress of late, and that this progress has een due to the splendid work of administration and the policy which has embarked in a large extension f irrigation works and railways. The only point hich I would venture to criticise in the paper is that, accounting for the undeveloped condition of the normous industrial wealth of India, whilst it very roperly lays great stress on the absence of demand, onsequent on the low social conditions of a large umber of the natives of India, it fails to attach any nportance to the question of unlimited foreign ompetition, which has crushed out the once flourish- ig industries of India, and which now forms a great npediment to the development of India's industrial esources. As long ago as 1885 I wrote an article in e *Calcutta Review*, from which the following is an xtract :—

"India has untold wealth, wonderful natural re- ources, whether agricultural, mineral, or industrial; ut they are, to a great extent, dormant. It has coal of an excellent quality, it has fine petroleum, large quantities of timber and charcoal; it has iron of a purity that would make an English iron-master's mouth water, spread wholesale over the country, in most places to be had by light quarrying over the surface : it has chrome iron capable of making the finest Damascus blades, manganiferous ores ; splendid hematites in profusion. It has gold, silver, lead, antimony, tin, copper, plumbago, lime, kaolin, mica, gypsum, precious stones, asbestos ; soft wheat, equal to the finest Australian ; hard wheat, equal to the finest Kabanka. It has food grains of every descrip- tion ; oil-seeds, tobacco, tea, coffee, cocoa, sugar, spices, lac, dyes, cotton, jute, hemp, flax, coir, fibres of every description ; in fact, products too numerous to mention. Its inhabitants are frugal, thrifty, in- dustrious, capable of great physical exertion, docile, easily taught, skilful in any work requiring delicate manipulation. Labour is absurdly cheap, and the soil for the most part wonderfully productive, and capable of producing crop after crop without any symptoms of exhaustion. The present yield of wheat is about 26,500,000 quarters in excess of the total imports of wheat into England ; and, in the Pubjab alone, there is cultivable waste land sufficient to produce 12,000,000 quarters, besides enormous tracts in Burmah, and other parts of India, only requiring irrigation or population to bring them under the plough. . . . . Everywhere in India may be seen evidence of native iron manufacture crushed out by unlimited foreign competition. Throughout the whole country may be found old slag-heaps, testi- fying to the former prosperity of native iron indus- tries ; the splendid native iron being superseded by cheap, worthless iron of foreign manufacture."

The coal fields of India, so far as they have been explored, cover an area of 35,000 square miles, and are estimated to contain 20,000,000,000 tons. Some of the seams are from 70 to 100 feet thick. In Bengal and Assam there is a coal nearly equal, in evaporative power, to medium Welsh steam coal, though not equal to Aberdare. Ball, in his "Economic Geo- logy" says that in some parts of India the develop- ment of iron ore is "on a scale of extraordinary and almost unparalleled magnitude, whole hills and ranges being formed of the purest varieties of it."

There is also in India the potential energy of millions of horse-power in water flowing from the Western ghats, which might be devoted to industrial purposes, but which is only used in the irrigation of the deltas, when it has nearly reached sea-level.

Sir Lepel Griffin, speaking about two years ago on the subject of India's industrial resources, pointed out that the questions of Free Trade and Protection which differed in every part of the world "must in India be discussed with instant and direct regard to the interests of India itself." He urged the desira- bility of imposing duties in India to encourage Indian arts and manufactures, and also for revenue purposes "to raise the dead weight of taxation from the land," and that it was necessary that the question should

not be decided on English grounds, or by English people, but by the Government in Calcutta, in the interests of India alone. No attempt has been made to foster trade between India and the mother country, or the colonies, by the interchange of concessions which would be mutually advantageous. Capital will not flow to those countries in which its operations are checked, and its struggling industries swamped, by unlimited foreign competition. Sir Charles Elliott, formerly Public Works' Minister in India, wrote in the *Empire Review* of last May:—"It seems to be clearly established that it is possible to introduce a preferential treatment of all British dutiable goods imported into India, and of certain dutiable goods imported into England with great mutual advantage," and Lord Curzon lately remarked:—"Whatever the merits of Free Trade as a system suited to these or those national circumstances, it probably carries with it a defect of its qualities in inducing too great apathy towards the exertion of Governmental action in trade matters. Non-interference, 'laissez faire,' may easily degenerate into an indolent attitude of mind, and then it is politically vicious."

The imports into India now amount in value to £54,000,000 annually, and a moderate duty on these imports would not be felt by the masses, but would raise a revenue which would afford material relief where most needed in reducing the land taxes. I cannot quite agree with Mr. O'Conor that there is no field for the export of Indian industries. There can be no doubt that India has every requisite for manufacturing at a low rate of cost, and there is no reason why, with a well-considered system of customs duties, she should not supply both England and the Colonies with those things which they cannot produce. As regards internal consumption, the statistics of our imports show that there is a large and increasing demand. Take, for example, sugar, which India is in a position to manufacture as cheaply as any country in the world, yet sugar, probably bounty-fed, to the value of about £4 000,000 sterling is imported into India annually. Take again cotton, which India can grow in such abundance that in 1901-02 she exported it, in its raw state, to the value of about £9,000,000 sterling; yet the value of manufactured cotton goods imported into India during the same period amounted to more than £20,000,000. India formerly produced excellent cotton, but it has degenerated, and is of short staple. The Inspector-General of Agriculture declares that our knowledge of indigenous cotton is incomplete, and although it has deteriorated, its degeneration is not due to inferior cultivation or to exhausted soil, for the black cotton soil is very fertile; but he attributes the deterioration to the "continuous use of the same strain of unselected seed." Others also say that the short staple is due to a great extent to careless and improper cropping. Be this as it may, there is very little doubt that if the cotton-growing industry in India had been fostered, the qu[ality] would have been improved, and the quan[tity] ncreased, and Lancashire would not have b[een] dependent on the speculations of American co[tton] rings for its supply. Again, taking the questio[n of] the demand for iron and steel. The London [and] North Western Railway Company, with its 300 or [so] miles of railway, manufactures its own steel rails, ch[airs,] permanent way material, bridges, locomotives, [and] carriages, and surely India, with its 27,000 mile[s of] railway, ought to be sufficient to support a dem[and] for internal consumption. It has been said [that] Lord Kitchener intends that India in its a[rmy] supplies shall be made self-supporting, and in[de]pendent of other countries; and it is to be hoped [that] if such a policy is to be carried out it will be a s[tep] towards the development of India's great [and] undeveloped industrial wealth.

General Notes.

COTTON GROWING.—Reports from the Colony [of] the Gambia, from Lagos, and Mozambique respect[ing] experiments in cotton-growing are quoted in [the] *Board of Trade Journal*. It is stated that [the] experiments in the Colony of the Gambia, begun [in] 1902, have proved encouraging, especially in [the] Upper River Districts. About 150 tons of unginn[ed] cotton grown during 1903 have been received by t[he] cotton expert this year, and it is hoped that the a[rea] under cultivation will be greatly extended this seas[on]. The experiments in cotton cultivation in the territor[y] of the Mozambique Company have been fully succe[ss]ful. The fact that the climate and soil are admiral[bly] adapted to the production of long staple cotton of t[he] best quality seems now definitely established.

MEETINGS FOR THE ENSUING WEE[K].

TUESDAY, JUNE 21. Statistical, 9, Adelphi-terrace, W. 1. "The Third Report from the Society's Com[mittee] on Meat and Milk Production." 2. Mr. Henry Rew, "Observations on the Production [of] Meat and Dairy Products in the United Kingdom."

WEDNESDAY, JUNE 22..SOCIETY OF ARTS, John-stre[et,] Adelphi, W.C., 5 p.m. Colonel Viktor Bal[ck,] "The Northern Games in Stockholm and Swed[en] and its People."
Geological, Burlington-house, W., 8 p.m.
Royal Society of Literature, 20, Hanover-squa[re,] W., 8½ p.m.

THURSDAY, JUNE 23...Antiquaries, Burlington-house, W., 8½ p.m.

FRIDAY, JUNE 24...Society of Women Journalists (at t[he] HOUSE OF THE SOCIETY OF ARTS), John-stre[et,] Adelphi, W.C., 8½ p.m. Mr. Spencer Lei[gh] Hughes, "The Ethics of Journalism."
East India Association, Westminster Palace Hot[el,] S.W., 4½ p.m. Mr. J. B. Pennington, "A Su[g]gestion for the Abolition of the Salt Monopoly."
Physical, Royal College of Science, South Ke[n]sington, S.W., 5 p.m.

Journal of the Society of Arts.

No. 2,692. Vol. LII.

FRIDAY, JUNE 24, 1904.

[All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

FINANCIAL STATEMENT.

The following statement is published in this week's *Journal*, in accordance with Sec. 40 of the Society's By-laws :—

TREASURERS' STATEMENT OF RECEIPTS AND PAYMENTS FOR THE YEAR ENDING MAY 31ST, 1904.

Dr.

	£ s. d.	£ s. d.
To Cash in hands of Messrs. Coutts and Co., 31st May, 1903		2,564 19 8
,, Subscriptions	5,702 11 0	
,, Life compositions	315 0 0	
		6,017 11 0
,, Dividends and Interest		620 11 4
,, Ground Rents		637 15 0
,, Examination Fees		2,676 19 0
,, Clothworkers' Company (Donation to Examination Prize Fund)		30 0 0
,, Conversazione, 1903 (sale of tickets)		101 15 0
,, Advertisements		880 12 6
,, Sales, &c. :—		
"Cantor" Lectures	23 2 6	
Examination Programmes	38 15 9	
Fees for use of meeting-rooms	42 10 6	
Journal	171 19 1	
		276 7 10
		£13,806 11 4

Cr.

	£ s. d.	£ s. d.
By House :—		
Rent, Rates, and Taxes	842 5 4	
Insurance, Gas, Coal, House expenses and charges incidental to meetings	309 16 0	
Repairs and Alterations	193 14 0	
		1,345 15 4
,, Office :—		
Salaries and wages	2,229 17 10	
Stationery, Office Printing and Lithography	458 5 11	
Advertising	108 4 0	
Postage Stamps, Messengers' Fares, and Parcels	326 8 11	
		3,122 16 8
,, Library, Bookbinding, &c.		127 15 9
,, Conversazione (1903)		492 0 0
,, *Journal*, including Printing and Publishing		2,118 0 9
,, Advertisements (Agents and Printing)		274 11 6
,, Examinations		2,373 19 11
,, Medals :—		
Albert	21 0 6	
Society's	21 18 0	
		42 18 6
,, "Swiney" Prize		200 0 0
,, "Owen Jones" Prizes		5 13 0
,, Drawing Society's Prizes		11 13 6
,, "Fothergill" Prize		33 5 6
,, "Mulready" Prize		19 0 0
,, North London Exhibition Prizes		14 14 0
,, "Cantor" Lectures		198 6 3
,, Juvenile Lectures		25 0 0
,, Sections :—		
Applied Art	62 0 0	
Colonial	44 15 1	
Indian	66 12 9	
		173 7 10
,, Committees (General Expenses)		17 15 10
,, Committee on Leather for Bookbinding		68 3 5
,, Investments :— Life Compositions for the year £315, and Society's Funds £500, in War Loan		815 0 0
		11,479 17 9
,, Cash in hands of Messrs. Coutts and Co., May 31st, 1904		2,326 13 7
		£13,806 11 4

Liabilities.

	£ s. d.	£ s. d.
To Sundry Creditors	588 5 1	
,, Examiners' Fees	814 11 0	
,, Examination Prizes and Medals	123 0 0	
,, Sections :—Applied Art, Colonial, and Indian	170 0 0	
,, Accumulations under Trusts	307 3 3	
		2,002 19 4
,, Excess of assets over liabilities		24,679 4 3
		£26,682 3 7

Assets.

	Amount of Stock, &c. £ s. d.	Worth on 31st May, 1904. £ s. d.	£ s. d.
By Society's Accumulated Funds invested as follows :			
Consols	1,976 5 7	1,793 9 5	
Canada 4 per Cent. Stock	500 0 0	505 0 0	
South Australia 4 per Cent. Stock	500 0 0	510 0 0	
N.S. Wales 3½ per Cent. Stock	530 10 1	525 3 10	
N.S. Wales 4 per Cent. Stock	500 0 0	550 0 0	
G. Indian Pen. Ry. 4 per Cent. Debenture Stock	217 0 0	264 15 0	
Queensland 4 per Cent. Bonds	1,500 0 0	1,560 0 0	
Natal 4 per Cent. Stock	500 0 0	560 0 0	
Ground Rents (amount invested)	10,496 2 9	10,496 2 9	
New River Co. Share (New)	100 0 0	370 0 0	
National War Loan	3,573 1 1	3,537 6 0	
			20,671 17 0
	20,392 19 6		
,, Subscriptions of the year uncollected		732 18 0	
,, Arrears, estimated as recoverable		256 0 0	
			988 18 0
,, Property of the Society (Books, Pictures, &c.)			2,000 0 0
,, Advertisements due			294 15 0
,, Cash in hands of Messrs. Coutts and Co., 31st May, 1904			2,326 13 7
,, Do. on Deposit (against interest on Trusts)			400 0 0
			£26,682 3 7

Funds held in Trust by the Society.

	£ s. d.	
Dr. Swiney's Bequest	£4,477 10 0	Ground-rents, chargeable with a sum of £200 once in five years.
"John Stock" Trust	100 0 0	Consols, chargeable with the Award of a Medal.
"Benjamin Shaw" Trust for Industrial Hygiene	133 6 8	,, ,, ,, of Interest as a Money Prize.
North London Exhibition Trust	102 2 1	,, ,, ,, ,,
"Fothergill" Trust	388 1 4	,, ,, ,, of a Medal.
J. Murray, in aid of a Building Fund	54 18 0	,,
Subscriptions to an Endowment Fund	562 2 2	,,
Dr. Aldred's Bequest	220 2 3	,, chargeable with the Award of a Prize.
Thomas Howard's Bequest	500 0 0	Metropolitan Railway 4 per Cent. Perpetual Preference Stock, chargeable with the Award of a Prize for an Essay.
Dr. Cantor's Bequest	2,450 0 0	Bombay and Baroda Railway Stock } Interest applied to the Cantor Lectures.
	2,695 11 3	Ground-rents }
"Owen Jones" Memorial Trust	423 0 0	Canada 4 per Cent. Stock, chargeable with the Award of Prizes to Art Students.
"Mulready" Trust	105 16 0	South Australia 4 per Cent. Stock, the Interest to be applied to keeping Monument in repair and occasional Prizes to Art Students.
Alfred Davis's Bequest	1,953 0 0	Great Indian Peninsula Railway 4 per Cent. Guaranteed Debenture Stock. Interest at the disposal of the Council for promoting the objects of the Society.
Amount to cover accumulated Interest on Trust Funds	400 0 0	On Deposit with Messrs. Coutts and Co.
	£14,655 9 9	

Total of Investments &c., Standing in the Name of the Society (including Society's accumulated Funds and Trusts as above).

	£ s. d.
Ground Rents (amount of cash invested)	£17,669 4 0
Consols	3,626 18 1
Metropolitan Railway 4 per Cent. Perpetual Preference Stock	500 0 0
Bombay and Baroda Railway 5 per Cent. Guaranteed Stock	2,450 0 0
Canada 4 per Cent. Stock	923 0 0
South Australia 4 per Cent. Stock	605 16 0
New South Wales 3½ per Cent. Stock	530 10 1
New South Wales 4 per Cent. Stock	500 0 0
Great Indian Peninsula Railway 4 per Cent. Guaranteed Debenture Stock	2,170 0 0
Queensland 4 per Cent. Bonds	1,500 0 0
Natal 4 per Cent. Stock	500 0 0
New River Company Share (New)	100 0 0
National War Loan	3,573 1 1
Cash on Deposit with Messrs. Coutts and Co.	400 0 0

Society's Accumulated Funds	20,392 19 6	£35,048 9 3
Trust Funds held by Society	14,655 9 9	

The Assets, represented by Stock at the Bank of England, and Securities, Cash on Deposit, and Cash balance in hands of Messrs. Coutts and Co., as above set forth, have been duly verified.

Owen Roberts,
Carmichael Thomas, } *Treasurers.*

Henry Trueman Wood, *Secretary.*
Society's House, Adelphi, 20th June, 1904.

Knox, Cropper, and Co., *Auditors.*

ANNUAL GENERAL MEETING.

The Council hereby give notice that the One Hundred and Fiftieth Annual Meeting for the purpose of receiving the Council's Report and Treasurers' Statement of receipts, payments, and expenditure during the past year, and also for the election of officers and new members, will be in accordance with the By-laws on Wednesday, 29th June, at 4 p.m. (By Order of the Council),

HENRY TRUEMAN WOOD,
Secretary.

CONVERSAZIONE.

The Society's Conversazione will take place at the Royal Botanic Gardens, Regent's-park, on Monday evening, June 27th, from 9 to 12 p.m.

The Gardens will be illuminated with coloured lamps, and also by the Kitson Incandescent Oil Light.

An Exhibition of Growing and Cut Roses and other Flowers will be arranged in a marquee in the grounds by Messrs. W. Paul and Sons.

A Selection of Music will be performed by the String Band of the Royal Artillery in the Conservatory, and by the Band of H.M. Irish Guards in the Gardens, commencing at 9 o'clock.

A Vocal and Instrumental Entertainment, under the direction of Mr. H. Tipper, will be given at intervals in the Club House.

The reception by Sir William Abney, K.C.B., D.C.L., F.R.S., Chairman, and other Members of the Council, will be held at the entrance of the Conservatory, near the Broad Walk, from 9 to 10 o'clock.

Each member is entitled to a card for himself (which will not be transferable), and a card for a lady. The cards are now issued. In addition to this, a limited number of tickets will be sold to members of the Society, or to persons introduced by a member, at the price of 5s. each, if purchased before the date of the Conversazione. On that day the price will be raised to 7s. 6d.

Members can purchase these additional tickets by personal application, or by letter addressed to the Secretary. In all cases of application by letter a remittance must be enclosed. Each ticket will admit one person, either lady or gentleman.

Tickets will only be supplied to non-members on presentation of a letter of introduction from a member.

Light refreshments (tea, coffee, ices, claret cup, &c.) will be supplied.

VIVA VOCE EXAMINATIONS IN MODERN LANGUAGES.

The following is a list of the *Vivâ Voce* Examinations which have been held since the last announcement in the *Journal* for May 15, 1903:—

Place of Examination.	Date.	Number of Candidates.	Passed with Distinction.	Passed.	Failed.
French :—					
Acton and Chiswick Polytechnic (Middlesex Education Committee)	May 29, 1903.	38	4	24	10
Queen's-road School, Dalston (London School Board)	June 30, 1903.	22	6	9	7
Offord-road School, Barnsbury (London School Board)	July 7 and 10, [1903.	50	7	33	10
Lavender-hill School (London School Board)	July 8, 1903.	23	5	16	2
Merchant Venturers' College, Bristol..........	July 9 and 10, [1903	47	2	26	19
Crouch-end Board School (Middlesex Education Committee)	March 28, 1904	29	4	15	10
Acton and Chiswick Polytechnic (Middlesex Education Committee)	March 29, 1904	36	3	23	10
Regent-street Polytechnic	March 30, 1904	35	3	24	8
Manchester Education Committee	May 10, 1904.	15	2	9	4
Birkbeck College (Candidates from London Polytechnics)	May 13, 1904.	43	3	33	7
Mansfield-road School, Gospel Oak (L.C.C. Education Committee)	June 8, 1904.	23	1	16	6
Lavender-hill School (L. C. C. Education Committee)........	June 9, 1904.	12	2	5	5
German :—					
Merchant Venturers' College, Bristol	July 14, 1903.	25	—	14	11
Regent-street Polytechnic	April 18, 1904.	24	4	9	11
Manchester Education Committee	May 13, 1904.	11	3	4	4
City of London College (Candidates from London Polytechnics).....	May 30, 1904.	15	4	7	4
Spanish :—					
Manchester Education Committee	May 11, 1904.	18	2	7	9
Portuguese :—					
Manchester Education Committee	May 12, 1904.	10	—	9	1
		476	55	283	138

The Examiners were Mr. E. L. Naftel for French, Professor H. G. Atkins, M.A., for German, Professor Ramirez for Spanish, and Mr. J. d'Oliveira e Silva for Portuguese.

Proceedings of the Society.

ADDITIONAL MEETING.

Wednesday afternoon, June 22nd, 1904; The Lord Chief Justice, G.C.M.G., Vice-President, in the chair.

THE NORTHERN GAMES IN STOCKHOLM AND SWEDEN, AND ITS PEOPLE.

By Col. Viktor Balck.

In connection with the London meeting of the International Olympic Games Committee, a lecture on the "Northern Games of Stockholm," illustrated by a series of lantern slides, was delivered by Colonel Viktor Balck, President of the Northern Games Committee.

Colonel Balck said he had the honour, before commencing his lecture, of presenting to Lord Alverstone, on behalf of the Central Union of Sweden for Promoting Sports, a token of their esteem, and thanks for his kindness in presiding at the meeting. The token consisted of the silver badge of Northern Games.

The lecturer said he proposed to take the company on an imaginary visit to Sweden, and to call their attention to the winter sports of that country. The Swedes prided themselves on those sports, just as the English prided themselves on the numerous games and pastimes which were carried on in the British Isles. The Swedes, like the people of other countries, looked upon the English as the most sport-loving people in the world, and he hoped to interest the audience in the sports of Scandinavia which the Scandinavians valued as especially their own. He proposed to show the audience with the help of the lantern how the great winter contest called the Northern Games were carried on. These games were instituted by Swedish sportsmen with the object of bringing together at regular intervals those persons who practised winter sports and took part in matches requiring strength and skill. The games in question took place in Stockholm every four years, and there was an intention to repeat them in Norway in the intervals between the four year period. They would thus be always taking place during the winter in the Scandinavian cities which were most suitable for such proceedings. Many persons who excelled in the games were to be found in Sweden and Norway. The Scandinavian countries and the Scandinavian climate afforded numerous opportunities of sports of great interest during the winter. Nature was exceedingly beautiful during that period, and these countries possessed excellent means of communications and all the advantages of civilisation. The Northern Games began in Stockholm in February, 1901. The idea was a daring one, and the difficulties were many, but the success was complete. The games met with the most cordial reception. All these sports were of a genuinely national character, and the weather favoured the games. They were presented in the midst of unique surroundings. Cold snowstorms on one or two occasions only served to heighten the effect of the feats of strength and endurance. There was not a single instance of anyone absenting himself, though once or twice the cold reached from twenty to thirty degrees Centigrade below the freezing point. The games would be repeated in February, 1905.

The lecturer exhibited on the screen representations of the various events of the successive days on which the sports were held. These included ordinary skating, figure skating, riding races on horseback, cross country riding, tobogganing, sleighing, curling, ski-running, ice-boat sailing, and sailing on skates. As to the last-mentioned exercises, the speed, said the lecturer, was limitless if only the skater could keep on his feet. Some of the sail-skaters maintained that under certain circumstances they could travel a little faster than the wind. Several pictures were given representing the sport of ski-ing down the declivities of hills, and some photographs of the competitors making those startling and enormous leaps which had drawn so much attention to this specially Swedish sport. It was difficult to believe, but it was nevertheless a fact, that a skilful ski-runner could, after sufficient impetus had been gained by the descent of a slope, cover a distance of 80 or 90 feet, with a drop of 50 or 60. Ski matches took place all over Sweden.

A series of views illustrating the picturesque inland scenery of Norway and Sweden was also exhibited. Here and there were to be seen examples of the sporting huts built by the Swedish Tourists' Association as night shelters for travellers. The lecturer drew attention to the resemblance of some of the sports of Sweden to those of Scotland. Diving and swimming were assiduously prac-

ised by the Swedes. The most celebrated physical exercises in Sweden consisted of gymnastics. The practice of gymnastics was compulsory in every school.

In several of the scenes depicting the Northern Games the King of Sweden and members of the Royal Family appeared as interested and appreciative spectators.

The Lord Chief Justice said that he was sure that the meeting would wish him to express their hearty thanks to Colonel Viktor Balck for his most charming lecture and for the delightful and graphic way in which he had described these most interesting games and the beautiful scenery of Sweden and Norway. He (Lord Alverstone) regretted that he was himself not young enough to go to Sweden and take part in the games, and he wished that he had sufficient leisure from his duties to go to witness them, even though he could not take part in them.

Baron P. de Coubertin was then asked by the Chairman to make a statement with regard to the revival of the Olympic Games. He stated that their organisation was started ten years ago, and held its first meeting in Paris. About seventeen different countries were represented at the gathering, and over one hundred societies sent delegates. On that occasion it was decided unanimously that the Olympic Games should be revived, and that the first performances should be held in Athens in 1896. This decision was carried out, and over seventy thousand people attended. The second meeting was held during the Paris Exhibition of 1900, and the third was taking place this year at St. Louis, in America. The next games were to take place in 1908. A meeting of the International Committee had been held in London under the patronage, he was glad to say, of His Majesty the King, and it had been decided unanimously that the games of 1908 should be held in Rome. He might be allowed to quote a few Latin words with regard to the moral side of the international revival of the Olympic Games. The words which he was thinking of were *si vis pacem, para bellum.* He wished to turn that saying round the other way, any say, *si vis bellum, para pacem.* By this he meant that, if the different countries wanted to join in the contests and have good sport, they must begin by making friends with one another. There could not be good sport without a strong feeling of international friendship, and the promotion of that sentiment was the work which the International Committee were doing. They were workers for international good will and nothing more and nothing less. The Baron concluded by proposing a vote of thanks to the Lord Chief Justice who had done them the honour of occupying the chair.

Sir Howard Vincent, in seconding the motion, said that the Lord Chief Justice was one of the best sportsmen which the country had ever had, and they only wished that, as he had said, he was young enough to take part in the Northern sports, the representation of which by Colonel Balck had given the meeting such great pleasure.

The vote of thanks having been agreed to,

The Chairman said it was interesting to see the connection which Colonel Balck had suggested between some of the Scandinavian games and certain sports practised in the British Isles. He could not imagine anything which required more nerve and courage and coolness than the sport of ski-ing, involving the magnificent jumps which were made by the ski-runners. Such sports as ice-boat sailing and ski-running were impossible in England, but he believed that they greatly tended to promote nerve and judgment. He wished to thank Baron De Coubertin for bringing before the meeting the subject of the revival of the Olympian Games. He was sure that the meeting had spent a most pleasant hour and a half.

Miscellaneous.

COTTON INDUSTRY.

The following article on the Cotton Industry in the West Indies is taken from the *Agricultural News* (Barbados):—

In spite of many adverse circumstances the cotton crop now being reaped, though small in quantity, is proving of excellent quality everywhere in the West Indies. In this connection it may be interesting to mention that the Secretary of the British Cotton Growing Association reports that a consignment of cotton just received from Barbados is valued at from 16d. to 17d. per lb., and is considered the best Sea Island cotton which has yet been imported from the West Indies.

The cotton ginneries at Barbados, Montserrat, Antigua and Nevis, are in full working, and it is expected that regular shipments of cotton, on a commercial scale, will take place during the next few weeks. The yield, as already stated, is not so large as was anticipated, owing to the unfavourable season and the attacks of the cotton worm. It is felt, however, that with the experience now gained, the

cotton worm and other difficulties should be successfully dealt with during the coming season.

The question of low freight for cotton is occupying a good deal of attention. It is probable that the present rates (65s. per ton weight) will have to be reduced, as there are indications that through shipment, *viâ* New York to Liverpool or Manchester, may be possible at about 45s. per ton weight.

The great point in establishing the cotton industry is to obtain careful and intelligent action in cultivating the crop of 1905, and ensure that the utmost effort is made to obtain not only cotton of good quality, but in such quantity as to make the industry remunerative. The experience so far gained should prove of great service in this direction. The heavy rains and strong winds, experienced during the past season, cannot be provided against; but as regards better cultivation and the treatment of the cotton worm, there should be great improvement in all directions.

The first important matter to arrange for is the destruction of all old cotton plants at the end of the present crop so as to leave nothing for insects and other pests to feed upon to carry them over until the next crop. There should be no attempt to ratoon any areas in cotton this year. Those who do so will only have themselves to thank, if their plants are affected with disease and the crop is injured. Nothing can justify any attempt at carrying over a ratoon crop this year. It is hoped that no one will attempt anything of the kind. The risk is too great, and, besides, the yield of a ratoon crop from the present plants is likely to be so small as to be hardly worth the trouble.

The next point is carefully to select new land for the next planting. The soil should be good and deep, of a light loamy character, and in a sheltered and accessible situation. The land should be ploughed or forked and well broken up so as to form a mould. The locality should not be a wet one. A rainfall exceeding 80 inches per annum may be regarded as probably too heavy for profitable cotton growing.

The selection of good seed has been urged so often that it is hardly necessary to repeat recommendations under this head. None of the seed grown this year in the West Indies should be used for planting purposes. The Imperial Department of Agriculture is prepared to supply the best seed direct from the Sea Islands at cost price. Further, this seed will be disinfected beforehand.

Perhaps the most important point of all is to prepare for the attacks of the cotton worm. This attacks cotton everywhere. It is proved, however, that the treatment with Paris green and lime is absolutely trustworthy, if applied in time. For every acre planted in cotton there should be kept at hand, ready for use for the cotton worm, at a moment's notice, at least 3 lbs. of Paris green and 18 lbs. of slaked lime; also bags of coarse osnaburg for distributing the mixture, consisting of one part of Paris green to six parts of lime. Those who are prepared to carry out fully these suggestions and give close atte tion to the cultivation and care of their cotton field need have little or no anxiety as to the future of tl cotton industry in these colonies.

SWINEY PRIZE CUP.

The accompanying figure shows the modification (Maclise's design for the Prize Cup, which has bee adapted to meet the circumstances of the presentatio for this year, when two cups were prepared for th two recipients. As already announced in the *Journa* the Swiney Prize for the present year was awarded i January last to Sir Frederick Pollock, Bart., an Professor F. W. Maitland for their book on "Th History of English Law before Edward the First, The design for the original cup was prepared b Maclise, and for the present occasion this has bee slightly modified by Messrs. R. and S. Garrard an Co., to whom the preparation of the cup has alway been entrusted. It is in the style of 16th centur Renaissance, ornamented with decoration in lov relief. The body of the cup is a finely chased pane representing the "First Trial by Jury." The figur on the cover of the cup represents Justice.

This illustration has been kindly lent by the pro prietors of the *Graphic*.

Correspondence.

STATISTICS OF THE IRON AND STEEL INDUSTRIES.

It is a custom in Courts of Justice that the counsel r the defence should be allowed the last word. As, erefore, the defender of my own paper I may, rhaps, beg to be allowed a rejoinder to Mr. Burt's mmunication of May 30th. The point at issue is hether a comparison of the margin between exports id imports is a legitimate one if expressed in its od-purchasing equivalent. I have given for thirty-e years for the United Kingdom the margin in irrency and in its equivalent. I have pointed out at such currency margins have only existed since 894 in the United States and since 1880 in Germany. urrency comparisons are of value when comparing cent years of various countries; but widely sepa-ted periods in which the purchasing value of gold ay vary, require correction for this fluctuation. If I id taken, say, the prices of all commodities rather ian food stuffs only, I should have laid myself open the more serious criticism that the very factor of mparison employed included fluctuations in iron id coal prices. Had I, however, taken the index umber of all prices for the United Kingdom I had ot grievously erred in stating the British position. would be an easy matter for Mr. Burt to prepare ich a Table.

Contrasting only the margin between exports and nports for one country over a period of years, in rging the legitimacy of my comparison, I must emind Mr. Burt that in its final stage all inter-ational commerce is a barter of the products of one ountry for the products of another. British exports f manufactured goods are in the main bartered for ood stuffs and raw material. German and American xports are bartered for goods of a different character, erefore, the factor which is a fair one in computing ritish external trade cannot be properly applied to iose of countries whose produce is exchanged mainly r commodities differing in nature. Inconsistent, relevant, and incomplete are the terms now applied me. What can be more inconsistent than to sug-est my measuring the volume of our external iron id steel commerce in its coal-purchasing value, hen we do not barter steel plates for lignite, riquettes, or anthracite? What can be more irrele-ant to the issue than a suggestion that the margin hould be measured in rates and taxes?

Incompleteness I conceded in the paper itself. Ir. Burt states, "The internal consumption is known i regard to iron and steel and better known probably han in any other industry." He is alluding, I resume, to the annual statistical statements of an ssociation of manufacturers. These are not gener-lly accessible. The libraries of the Society of Arts, f the Royal Statistical Society, even of the Iron and Steel Institute itself do not possess copies. Here is a chance for Mr. Burt's charity, that he should present to this Society at least a set of such works. I should then find it a less difficult matter to study them than at present. It is suggested that I despise "un-complicated and undeceiving tonnages." I quoted several such in my paper, and was properly reproved by Mr. Bennett Brough, who gave figures which showed that the values put a different construction on such figures. It has also been an interesting point in the tariff controversy that export tonnages have been rarely used in propaganda. Rather have we had values in £ sterling quoted and requoted by those who in their fiscal zeal outrun their statistical discre-tion. Weights and volumes are well enough for the rawest of raw materials. But who would buy loco-motives for aught but a scrap heap at a per ton rate? Or dynamos, or boilers, or sewing-machines? Yet locomotives, boilers, dynamos, and sewing-machines are among the exports which are largely dependent on the iron and steel and their allied trades, and among the productions which add to our internal wealth.

Finally, a review of our respective positions. I state that in regard to our iron and steel industries, a computation of the excess of exports over imports, when allowance is made for either the fall in food stuffs, or in all commodities, shows no retrogression in external trade. For internal trade we have only indirect evidences as to its prosperity. I appeal for direct evidence. On the other hand, Mr. Burt disputes my first premise, and failing to supply the evidence required regarding internal trade, advocates an experiment in tariff revision, forsooth, because other countries and colonies employ "protection." Neither into early economic history, when the United Kingdom was Protectionist, nor into the elements of political economy need I venture, which are really extraneous to the matter at issue.

W. POLLARD DIGBY.

Trafalgar-buildings, Charing-cross, London, W.C.
June 14th, 1904.

THE ECONOMIC AND INDUSTRIAL PROGRESS AND CONDITION OF INDIA.

Amongst the topics discussed in Mr. O'Conor's paper were (*a*) the apparent financial gain to the Indian Government through supersession of the automatic currency system and fixing an approximate gold-value to the rupee by legalised "regulation." But this is only the outside and surface of that trans-action. Though the "cost of exchange" has been rubbed off the face of the budget, that very hard fact —the burden inseparable from large and permanent excess of exports—could not be extinguished by any currency manipulation. So that as regards India's international commerce the effect of artificially raising the value of the rupee may be traced in the increased

percentage of that export-excess; while, as regards internal Indian trade and production, evidence of its cost is, so far, obvious in the "profits on coinage," which, during the last four years, amounted to £6,177,224—a penalty on production, levied from planters and ryots alike.

(*b*) Mr. O'Conor took the chief items of which the Home Charges consist, and this would be useful for many of his audience; but it does not touch the strictly economic branch of the argument. The mercantile items on the list are already included in his import returns, and thus do not form any portion of India's actual excess of exports. Even if the whole of these charges in England consisted of "visible" commercial transactions, the fact remains that those annual State payments are made in a foreign country, and have a totally different economic effect as compared with outlay of revenue within the country itself. If this United Kingdom had to pay for its civil and military pensions; the interest on its debt; and for its railway and other public works material, say to Germany, to France, or the United States, the economic pressure on our industrial and monetary condition would be readily perceived and felt. Quite apart from any argument on the details of those obligatory payments of Indian revenues abroad, the adverse economic effect of such perennial transfer must be realised when its aggregate amounts are considered. For instance, only in the six years up to 1902-3 the total sum of India's unbalanced excess of exports was Rx.132,755,900.

That Mr. O'Conor is himself sufficiently conscious of the gravity of this standing drawback on "the economic and industrial progress and condition of India," may be inferred from his remarks on the "burden in the expenditure abroad of taxes raised in India;" and his timely warning that the "greatest care should be taken to restrict the growth of the Home Charges." No doubt, he is well aware, that the only way to secure such restriction is, that this master country shall sustain some substantial share of those charges through which we maintain profitable sway over our Indian Empire; but this is another story.

(*c*) Mr. O'Conor's incidental dealing with the public debt of India was scarcely serious enough in its economic aspect. His remark, that of the whole debt two-thirds represents capital expended on railways (a statistic that needs verification): and is therefore "an asset," omits, at least, one essential item of huge amount. That is the fifty millions or more contributed from the revenues of India during a long series of years, towards guaranteed interest and up-keep of the Indian railway system. This has gone under, and does not appear in the face of the accounts (except in the Railway Administration Reports); but it has been, and is (more so if compound interest be considered a very heavy set off against the large credit claimed for railways as having facilitated the enormous increase of India's export trade; more so, since being supplemented by that grand international public work the Suez Canal, provided out by the revenue and credit of Egypt. As to the strictly financial results of Indian railway extension that was a shrewd observation by Mr. O'Conor, to the effect that "the railways have been one chief means of maintaining and causing the (comparatively moderate) increase of the land revenue, which forms nearly half of the whole net revenue of the Indian Government." This juxtaposition throws strong sidelights on some other passages in the paper, as also on the whole question of India's economic situation.

W. MARTIN WOOD.

THE REPRESSION OF THE BRITISH INVENTOR.

In a letter to the *Journal* of the Society of Arts, of the 26th of February, 1904 (see *ante* p. 323), Mr. Abel states that the United States Patent Laws are tyrannical, and operate to the prejudice of the inventor, and gives three reasons for his belief. These are, briefly—(1) Harsh requirements for division of an application into two or more applications; (2) Stubborn examiners and a vexatious course of appeal; and (3) The existence of four rules that have been laid down by the examiners of late years.

Since the establishment of the United States patent system, it has been the practice of the Patent Office, that from a requirement of the examiner for division, an applicant may petition, without the payment of a Government fee, to the Commissioner in person, by whom the question is always carefully considered. A recent decision of the United States Supreme Court apparently results in the necessity of an appeal to the examiners in chief at a cost of ten dollars. The practice as to division of an application has varied under different Commissioners, some permitting greater latitude than others in the joinder of inventions. But, in any case, dependent inventions may be joined in the same application; independent inventions must always be prosecuted in separate applications. A thorough examination as to the prior art, which consists of more than 700,000 United States patents, renders absolutely necessary a proper and thorough classification of inventions. This cannot be effected if independent inventions are joined in the same applications. If the British Patent Office attempts to make a thorough search as to novelty, it will soon find this to be true. Moreover, the number of United States patents is vastly in excess of British patents, and, therefore, a greater refinement of classification is necessary. Mr. Abel states that the inventor is under the "complete thraldom of an opinionated examiner." The six quoted words express three false statements:—(1) The jurisdiction of the examiner is not complete. He is the primary examiner. Any decision of his is subject to review, and upon any merely formal matter it will be reviewed by the Commissioner in person without Government charge. (2) The inventor is under no thraldom of

e examiner, for the reason that the examiner's cision is in no case final; inventors and attorneys io have an intelligent understanding of the American stem never have to complain of thraldom. (3) The aminers are not opinionated in the sense meant. iere are nearly forty primary examiners, each king pride in the development of the art under his arge. They are men versed in science, mechanics, d law. They know that the extent of the field of iowledge is constantly enlarging, in a great measure ie to American research and invention, and are illing and glad to learn from the inventors the facts hich extend this field of knowledge. The exniners, or many of them, spend much of their inual leave visiting shops and mills to obtain more timate and working knowledge of their art, thus oming in close touch with inventors, and always ideavour to grant them all the patent protection which they are entitled. There is no reason hy it should be otherwise. The United States 'atent Office at all times contains several scores of kaminers and assistant-examiners, who will evenually form a part, and a conspicuous part of the 'atent Bar of the land. Many of their clients will e those whose applications they are now passing pon. Why, then, should they treat them harshly, r with aught than full and equal justice? Looking t it from a selfish standport merely, it is absurd to ay that a man will hamper his future career by iaking for himself a reputation for harshness and everity. And looking at the matter from a higher tandpoint, it must be remembered that an examiner s an official who has sworn to do his duty. Every ne of them is proud of the United States patent ystem, and of the inventors whom it fosters. Be he inventor rich or poor, influential or obscure, he is ccorded equal courtesy. As a single instance, it nay be stated that recently an inventor, a poor man, who thought his presence necessary, came from the ar South-west at a cost he could ill afford. He was given a number of interviews and helped in every way, and finally went home happy in the assurance that his patent had been allowed. Had he been the richest manufacturer of the land he could have gotten no fairer treatment.

The number of applications filed and the number of patents granted, during the past five years, are as follows:—

	Applications.	Patents.
1899	41,443	25,527
1900	41,980	26,499
1901	46,499	27,373
1902	49,641	27,886
1903	50,213	31,699

Considering the percentage of cases allowed, and which the inventors do not patent, and for cases which are not prosecuted after the first official action (showing there is little or no novelty in the application), it will be seen that the percentage of applications maturing into patents is large. Where 40,000 applications are filed, from all sections of the world, and are carefully searched by the Patent Office as to the prior art of a half-dozen countries or more, it stands to reason that a considerable percentage of applications must be without patentable novelty. Yet it will be seen that three-fifths of the applications mature into patents.

Where an applicant replies promptly to the official actions, a patent may usually be obtained in the course of a few months. Often the first action is the allowance of the application, only a month after filing. Unless a case be involved in interference proceedings, it need not be pending in the Office more than a year. A case pending more than a year is the exception rather than the rule, and the reason is very apt to be the delay on the part of the attorney. To say that the inventor has to argue "with the examiner for years sometimes, before the latter will allow that the inventor has any patentable article at all" is to state something that very seldom, if ever, occurs and if it does occur there is no reason therefor. The inventor and the examiner may come to an issue with very little delay, and if dissatisfied, the inventor, for a fee of $10, may appeal, and will be heard within a month, and will get a very prompt decision. Mr. Abel's reference to an appeal to the Supreme Court is erroneous. Appeal lies from the Commissioner to the Court of Appeals of the District of Columbia but this is seldom taken except in an interference case.

Regarding the form of claims, the examiner's sole desire (aside from the consideration of novelty) is to obtain "a plain and straightforward expression of the invention, that anyone could readily understand," Mr. Abel's statement to the contrary, notwithstanding. Large latitude is left to the inventor. In applications filed by American attorneys and particularly by skilled attorneys, there is very little difficulty with the form of claims. In order that there may be certainty as to their scope, it is required that each element be definitely and directly included, and that the claim be not, what may be termed, rambling. Further than this the examiner seldom goes, and as before stated, any ruling of the examiner is subject to revision on petition to the commissioner.

Four alleged rules are laid down by Mr. Abel as follows, which will be separately considered:

Firstly,—You cannot have a patent for a method of operating unless this can be expressed entirely without reference to apparatus or machinery.

Secondly,—You must not, in a claim for construction of apparatus or machinery, introduce any description of the manner in which it operates—your claim must be limited to the enumeration of the cranks, levers, cams, &c., that constitute your machine.

Thirdly,—You cannot in one and the same patent include a method of operation and the machine or apparatus by which that method of operating is carried out.

Fourthly,—If your invention is capable of being carried out by several modified arrangements, you must take out a separate patent for each such modification, as each one is considered a separate invention.

First Alleged Rule.—"A method of operating," expressed by reference to apparatus or machinery, is very apt to be a mere function of the particular machine, and not a true method at all. In such case the invention resides in the machine, and therefore it is the machine that should be claimed. But numerous instances could be cited where a true "mechanical method" contains references to the mechanism by which it is carried out. The Patent Office recognises the fact, not only that a method may be carried out by machinery, but that it may, so far as known, be carried out by only one particular machine. A lengthy and convincing discussion upon this point, by the United States Supreme Court, will be found in the case of "Boydon Brake Power Company *v.* Westinghouse," 83 Official Gazette, 1067.

Second Alleged Rule.—No such rule exists. It is merely to cite the following claims upheld by the United States Supreme Court in "Morley Sewing Machine Company *v.* Lancaster," 47 Official Gazette, 267. Thousands of other claims might be instanced.

The combination in a machine for sewing shank-buttons to fabrics, of button-feeding mechanism, appliances for passing a thread through the eye of the buttons and locking the loop to the fabric, and feeding mechanism, substantially as set forth.

The combination, in a machine for sewing shank-buttons to fabrics, of a needle and operating mechanism, appliances for bringing the buttons successively to positions to permit the needle to pass through the eye of each button, and means for locking the loop of thread carried by the needle to secure the button to the fabric, substantially as set forth.

Third Alleged Rule.—Patent Office Rule 41, which prohibited the joinder of process and apparatus claims in the same application, has just been held invalid by the United States Supreme Court. See United States, ex rel. "Steinmetz v. Allen," Commissioner of Patents, 109 Official Gazette, page 549, March 8, 1904.

Fourth Alleged Rule.—Mr. Abel comes nearer stating the truth here than at any previous point. If an invention be capable of being carried out by several modified arrangements, a broad claim may be secured which will include each and every one of such arrangements, and all this may be done in one application. One application may show a number of substitute forms, but while a claim broad enough to cover them all may be allowed, only one form may be specifically claimed. If the applicant wishes to obtain a specific claim for each form, which generally may be regarded as unnecessary, he must file separate applications. It is obvious that two forms or arrangements of a device or mechanism which are entire substitutes for each other, are not dependent inventions, as they are entirely independent of each other; they do not co-operate in any way.

Since the alleged rules fall to the ground, the so-called result specified in the paragraph following them vanishes into thin air. Regarding the alleged "interminable arguments with an opinionated examiner," it may be noted that attorneys are daily allowed interviews with the examiner, the case is thoroughly discussed and patentable claims are agreed upon. The examiner is always glad to do this, and will give an inventor or his attorney all the time he wants for discussion.

The claim which Mr. Abel draws for James Watt is a curiosity. Of course, Mr. Abel is not serious in the matter, and hence it will do no harm to state that such a claim, if seriously presented, would show gross ignorance and carelessness.

As to the figures quoted by Mr. Abel, regarding the number of United States patents held invalid in whole or in part in the United States, it may be said that a large proportion, a very large proportion of these were held invalid only in part. Again, these patents, or many of them, were held invalid upon grounds not accessible to the Patent Office, such as the discovery of a prior anticipating device (not patented), or the existence of public use for two years prior to the application in spite of applicant's oath to the contrary. Again, patents litigated in 1896 were granted mainly before 1890, and the examination system and proper classification of patents are improving as time passes. Again, if the United States Patent Office had proper facilities and could give to the examination of each case as much time as is given by counsel when the patent is in litigation, comparatively few patents would be held invalid. Thus, the system of the United States is not at fault in the matter.

IRVING U. TOWNSEND,
Examiner of Textiles, U.S. Patent Office.

Obituary.

SIR WILLIAM HENDERSON, LL.D.—Sir William Henderson, a member of the Society since 1878, died on Thursday, 9th inst., at Devanha-house, Aberdeen. He was born in 1826, and in 1845 he went to Aberdeen to enter the employment of Mr. George Thompson, the founder of the Aberdeen line of steamers. He became a partner in 1850, and from 1854 to 1857 he took charge of the London branch of the business. He returned to Aberdeen, and took an active part in the affairs of that city throughout his life. He was for some years president of the Aberdeen Chamber of Commerce, and from 1886 to 1889 was Lord Provost. He was knighted in 1893.

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FRIDAY, JULY 1, 1904.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

CONVERSAZIONE.

The Society's Annual Conversazione was held in the Gardens of the Royal Botanic Society, Inner Circle, Regent's - park, on Monday evening, 27th ult.

The reception was held by Sir William Abney, K.C.B., D.Sc., F.R.S., Chairman, and the following members of Council:—Sir Mancherjee Merwanjee Bhownaggree, K.C.B., M.P., Mr. William Bousfield, Mr. Henry H. S. Cunynghame, C.B., Mr. Lewis Foreman Day, Mr. Francis Elgar, LL.D., F.R.S., Mr. Robert Kaye Gray, Colonel Sir Thomas Holdich, R.E., K.C.M.G., K.C.I.E., C.B., the Hon. Richard Clere Parsons, Sir Owen Roberts, D.C.L., Mr. Alexander Siemens, and Mr. Carmichael Thomas.

A Selection of Music was performed by the String Band of the Royal Artillery (Conductor, Cavaliere L. Zavertal, M.V.O.) in the Conservatory, and by the Band of H.M. Irish Guards (Conductor, Mr. C. H. Hassall) in the Gardens.

A vocal and instrumental concert was given in the Club House by the Royal Criterion Bell Ringers and Glee Singers, under the direction of Mr. Harry Tipper.

An Exhibition of Growing and Cut Roses and other Flowers were arranged in a marquee in the grounds by Messrs. William Paul and Sons, of Waltham Cross.

The Tropical House, containing the Giant Water Lily (Victoria Regia), which was in flower on the evening, was open to visitors.

The number of visitors attending the Conversazione was 2,075.

Proceedings of the Society.

ANNUAL GENERAL MEETING.

The Annual General Meeting for receiving the Report of the Council, and the Treasurers' Statement of Receipts and Payments, during the past year, and also for the Election of Officers was held in accordance with the By-laws on Wednesday last, the 28th ult., at 4 p.m., Sir William Abney, K.C.B., D.C.L., D.Sc., F.R.S., Chairman of the Council, in the chair.

The Secretary read the notice convening the meeting, and the minutes of the last annual meeting.

The following candidates were proposed, balloted for, and duly elected members of the Society:—

Abbott, Professor Frederick, A., Agricultural College, Mississippi, U.S.A.

Abercrombie, Hugh Romilly, care of the Standard Bank of South Africa, 10, Clements-lane, E.C., and P.O. Box, 784, Pretoria, Transvaal, South Africa.

Allen, Miss Geraldine, 7, Rue Belloni, Paris XV., France.

Babbs, Arthur Thomas, The Rhodes Building, St. George's-street, Cape Town, South Africa.

Bainbridge, Oliver, 43, Upper Bedford-place, W.C.

Baldwin, Henry P., Haiku, Island of Mani, Hawaii.

Blelock, Robert, Johannesburg, Transvaal, South Africa.

Bowles, Colonel Henry Ferryman, M.P., Forty Hall, Enfield, Middlesex.

Butcher, Herbert Thomas, A.R.S.M., F.I.C., Dorunkeh Chambers, Cobham Town, Old Calabar, West Africa.

Clark, William, 4, Snow hill, E.C.

Clews, Henry, LL.D., 11, Broad-street, New York City, U.S.A.

Cole, Professor J. Abayomi, Percival-street, Freetown, Sierra Leone, West Africa.

Collie, James V. B., 15, Barrack-street, Cape Town, South Africa.

Craigie, Mrs. Pearl Mary-Teresa, 56, Lancaster-gate, W.

Davidson, Thomas Edward, 32, Clayton-street West, Newcastle-on-Tyne.

Davis, Charles, 147, New Bond-street, W.

Dennis, William, F.C.S., 170, Albert-road, Jarrow-on-Tyne.

Dowling, T. Barrow, Mus.Doc., Thornhayes, Cape Town, South Africa.

Dudley, Mrs. Lucy Bronson, 80, Pine-street, New York, U.S.A.

Feitelberg, Samuel, Fairview, Main-road, Greenpoint, Cape Town, South Africa.
Felton, Henry James, 4, Beach-mansions, Southsea, Hants.
FitzGerald, William Walter Augustine, Carrigoran, Newmarket-on-Fergus, Co. Clare, Ireland.
Fleischmann, F. N. A., F.C.S., 6, Collingham-gardens, S.W.
Gardiner, James, Molyneux-park-mansions, Tunbridge Wells.
Grant, Lawford Stanley Foster, Assoc.M.Inst.C.E., 46, St. George's-avenue, Tufnell-park, N.
Green, Henry Lumb, Buenos Ayres, Argentine Republic, South America.
Hamlyn, John F., Grosvenor Works, Davies-street, W.
Hennessy, John F., City Chambers, 243, Pitt-street, Sydney, New South Wales, Australia.
Jones, Thomas, 40, Mount-pleasant, Liverpool.
Jones, Hon. William Hall, New Zealand.
Kelty, John Kenyon, M.A., P.O. Box 821, Cape Town, South Africa.
Kerly, Alexander William, The Gables, Horndon on the Hill, Grays, Essex, and 14, Great Winchester-street, E.C.
Kitching, Alfred, M.I.Mech.E., Superintendent's Office, Ocean Steam Ship Co., Singapore, Straits Settlements.
Ligertwood, T. G., Education Department, P.O. Box 4439, Johannesburg, Transvaal, South Africa.
Loubser, Matthew Michael, Port Elizabeth, Cape Colony, South Africa.
MacFarlaine, Robert Melbornie, care of Henry S. King and Co., 9 Pall Mall, S.W.
Macleod, Arthur William (Messrs. Fuller, Macleod and Co.), 9 Red Lion-court, Cannon-street, E.C.
Mallmann, Paul J., M.A., 116, Victoria-street, S.W.
Murdock, George J., 248, Sixth Avenue, Newark, New Jersey, U.S.A.
Nicholas, Askin, Bank-place, Collins-street, Melbourne, Australia.
Phillimore, Rev. Arthur, M.A., Brightwell-park, near Wallingford.
Ricketts, Dashwood Poyntz, Assoc.M.Inst.C.E., Imperial Railways of North China, Shan Hai Kwan, North China.
Shipway, Robert Bruce, The Bays, Hampton Wick.
Sperr, Professor Frederick W., Michigan College of Mines, Houghton, Michigan, U.S.A.
Storie, Edmund, Colonial Club, Whitehall-court, S.W.
Thanawalla, Dr. Framroze Cáwasjee, Aga Buildings, Bhendy Bazar, Bombay, India.
Thompson, Robert M., 3 East 69th Street, New York, U.S.A.
Tween, Charles Nelson, M.Inst.C.E., Goddards, Widford, Ware, Herts.
Usher, Sir Robert, Bart., 37, Drumsheugh Gardens, Edinburgh.
Williams, Gilbert Percy, M.Inst. C.E., 14, Victoria-street, Westminster, S.W.

The CHAIRMAN nominated Mr. Harry W. Barrow and Mr. William Keating, scrutineers, and declared the ballot open.

The SECRETARY then read the following

REPORT OF COUNCIL.

I.—ORDINARY MEETINGS.

The session commenced as usual with an Address from the Chairman of the Council, Sir William Abney, the subject selected for special consideration being Commercial Education. Sir William dealt, to a large extent, with the examination work of the Society of Arts, and by the interpolation of a curve deduced from the numbers of candidates entering for examination from the year 1883 to 1903, he showed that there was every probability of the present number of candidates being doubled in a period of five years. The prophecy, so far as regards the present year, appears to be not very far from the truth, the calculated number being 18,400, whereas the actual number of candidates in the Commercial subjects is nearly 18,000.

At the first meeting of the session after the opening meeting, Mr. G. F. Parker, the American Commissioner in this country for the St. Louis Universal Exposition, gave an account of the preparations which were then being made for this exhibition. Mr. Parker's anticipations were more than realised when the exhibition was opened on the 30th of April last, though the growing disinclination of British manufacturers to take part in these international competitions has been shown at St. Louis even to a larger extent than it was eleven years ago at Chicago.

Of the other papers before Christmas, two dealt with the Fiscal Problem—one by Sir Charles Kennedy, and a second by Sir William Preece. Both of these papers dealt with the subject in a non-political manner. Sir Charles Kennedy's long experience at the Foreign Office enabled him to put in a striking manner a great deal of statistical information about foreign trade, while Sir William Preece developed still further the thesis he had put forward in his Address as Chairman of the Council in November, 1902, that there is a true Science of Business with laws which can be deduced from experiment and from fact. In the other paper which was read in the earlier part of the session Mr. H. H. Cunynghame described the very ingenious

and convenient furnace which he has devised for laboratory work, especially for such work as enamelling and the production of small castings. The furnace is of quite simple construction, being merely built of fireclay mixed with some material which will after burning produce a porous mass, some binding material, such as wire-netting, being imbedded in order to bind the material together. The exterior of the furnace thus made is thickly covered with asbestos. The fuel which Mr. Cunynghame prefers to use in this furnace is petroleum burned in a Swedish blow-pipe lamp. It was shown that in a furnace of this construction the heat is very fully retained, hardly any being radiated from the exterior surface. The result of this is that the furnace is extremely economical and very effective.

At the first meeting after Christmas Mr. Thomas Casson read a paper on "Organ Design," while a few weeks later Mr. J. M. Coward read one on "Mechanical Piano Players." Both of these papers were fully illustrated. Mr. Casson had an organ of his own design built up in the room for the purpose, while Mr. Coward showed several typical mechanical pianos, and fully illustrated their capacity for playing various styles of music, and for accompanying vocalists. Mr. Gulston's paper on "Ice Breakers" derived special interest from the fact of public attention having been directed to the application of these vessels in the early stages of the war between Russia and Japan.

Two papers were devoted to the question of mechanical locomotion—one by Mr. Thomas Clarkson on "Steam Motors for Public Service," and one by Mr. Mervyn O'Gorman on "Popular Motor Cars." Professor C. V. Boys gave a very interesting paper on "Thermit"—the trade name for an aluminium compound, by the combustion of which intense local heat can be produced and various industrial processes, such as welding, soldering, &c., carried out. There were two papers which practically dealt with the question of housing rural and urban populations—that by Mr. A. R. Sennett on "Garden Cities," and one by Mr. T. Brice Phillips on "The Rural Housing Question." Building materials were dealt with also in two papers—Mr. Frank Tiffany on "Woods for Constructive and Decorative Purposes," and that by Mr. L. P. Ford on "Natural and Artificial Building Stones."

This session there was only one paper dealing with educational matters—that by Mr. J. C. Medd, on "Agricultural Education." In it he showed what progress had already been made in providing genuine technical training in agriculture, and urged that further effort should be made towards developing, alike continuation schools for agricultural teaching, and higher grade agricultural schools. Dr. Robert Jones treated the question of "Physical and Mental Degeneration" in a paper discussing the causes for such degeneration, though the Chairman at the meeting—Sir William Church—hesitated to admit that the condition of things was quite as bad as had been pictured.

Mr. Thomas Tyrer brought forward a very important subject in his paper on "Duty-free Spirit." He showed how many native industries were handicapped by the high cost of spirit compared with its cost in foreign countries, and urged that with proper safeguards the tax might, to a large extent be remitted on spirit for industrial applications without injury to the revenue, and with great profit to many manufacturers. Mr. W. P. Digby, in his paper on "The Statistics of Iron and Steel Industries," urged the necessity for more detailed statistics on the subject of iron and steel industries, and suggested that such statistics, if provided, would lead to a rather more favourable impression of the condition of British iron and steel-making than at present existed. Mr. Richard Holmes greatly added to the interest of his paper on "Painting in Miniature" by an admirable series of illustrations. He utilised the modern process of three-colour photography to reproduce as lantern slides some of the finest examples of probably the finest collection of miniatures in the world—that belonging to His Majesty at Windsor Castle, and under Mr. Holmes's charge. The appearance of these minute works of art, magnified to a scale which they were certainly never intended to approach, showed that they were quite able to bear comparison with work by the same artists executed the size of life.

An additional meeting of the Society was arranged for Wednesday, June 22nd, in connection with the London meeting of the "International Olympic Games Committee," in order to afford Colonel Viktor Balck, President of the Northern Games Committee, the opportunity of delivering a lecture on "The Northern Games in Stockholm." The Lord Chief Justice presided, and there was a large and interested audience. The Northern Games include Skating; Sleighing with Horses, Reindeer, and Teams of Dogs; Ski Running; Ski Jumping; Horse

Racing in Snow; Ice Yachting, &c. The lecture was very fully illustrated by a large series of photographs. Baron P. de Coubertin, President of the International Olympic Committee, who was present, also gave a short account of the Revival of the Olympic Games.

II.—Indian Section.

Testimony to the public services discharged from year to year by this Section was borne by the Secretary of State of India, Mr. Brodrick, M.P., who presided at the meeting in January, when Sir William Lee-Warner made a valuable contribution to the "Provinces of India" series of papers. This series began in 1901, and will be continued until the whole of the Indian Empire has been dealt with in similar detail. Sir W. Lee-Warner's subject was "The Presidency of Bombay," particular stress being laid upon the past glories and future prospects of India's Western Province.

Sir Thomas Holdich's paper, "Our Commercial Relations with Afghanistan," attracted considerable attention both here and in India. Speaking with a wide knowledge of Afghanistan, the author advocated the adoption of a bolder and more definite commercial policy with regard to that country. He also strongly advised the linking together of the Indian and Russian railway systems, which he believed would be the means of promoting friendship between the "two great Powers of Asia" and preserving peace. He thought that the Ameer's present determination not to have a railway in Afghanistan at any cost would disappear if we entered into "a direct agreement with Russia."

The Indian aspect of the fiscal question was raised in Mr. J. M. Maclean's able paper on "India's Place in an Imperial Federation." The author maintained that as "the one market in the world which is perfectly open to us" India has nothing in common with the aims of the self-governing colonies.

In the paper read by him on May 31, the distinguished ex-Director-General of Statistics, Mr. J. E. O'Conor, described the impressions of Indian economic conditions acquired by him during a prolonged period of service. After allowing for the marked advance that has been made and for the excellence of the Administration, there is, Mr. O'Conor affirms, no doubt that India is still an extremely backward country in comparison with Western nations. This backwardness, is in his opinion, due to various causes for the existence of most of which the State is not directly responsible, but the conditions might, he suggests, be improved by the adoption of certain administrative measures.

The remaining papers had to do with two Indian industries, one nascent, and the other long-established—China Grass and Tea. In dealing with the former subject, Mr. Frank Birdwood discussed the past, present and future of the fibre, concluding his excellent paper with some suggestions as to the manner in which State help might be given to rhea cultivation in India. Mr. A. G. Stanton's paper on "British Grown Tea" usefully supplemented previous papers on the subject, and gave a clear account of the position of an industry which in India alone gives employment to more than 500,000 natives and a large number of Englishmen. In the discussion various questions affecting the industry, such as the scarcity of labour, estate liquor shops, the increased duty, &c., were referred to.

III.—Colonial Section.

The principal feature of a successful session was the exceptionally large amount of interest aroused by the meeting at which Lady Lugard read a valuable paper on "Nigeria." The importance of the occasion was shown not only by the accommodation being insufficient for all who wished to hear the first account of Lady Lugard's impressions of our new tropical possession, and by the character of the audience, but by the special attention devoted to the proceedings by the press, English and African. Lady Lugard referred to the change that is taking place in the development of imperial and colonial questions. Hitherto the principal current of interest has been directed to the self-governing communities. Our next colonial chapter, she thinks, will be a tropical chapter. The vast possibilities of Nigeria as a cotton-growing country were touched upon, and the need for improved means of transit was also pointed out.

The danger which confronts the great cotton industry of this country, owing to an insufficiency of the raw material, was brought before the Society by Mr. Alfred Emmott, M.P., who, in an admirable paper, described the efforts that are being made by a powerful association to increase the area under cultivation, not only in Northern and Southern Nigeria, but in other parts of the Empire as well as in the Soudan. Sir Edward Grey, M.P., presided, and other prominent public

men of both parties took part in the discussion. This national and imperial question had not previously been fully placed before a London audience.

In a striking paper on "The Biology of the Empire" Sir John Alexander Cockburn traced the close analogy that he finds to exist between "the laws of life" and the various processes that have operated and are operating "to provide for the world-wide British possessions an organisation sufficiently elastic to permit the full play of the British genius for self government, and yet at the same time sufficiently co-ordinated for mutual purposes." Was Great Britain doomed to succumb in the struggle to some world power capable of higher organisation? Reason joins with instinct in assuring us that this cannot be.

Two other instructive papers were read—one by Mr. Ben. H. Morgan on "The Regeneration of South Africa," and the other by Mr. W. L. Griffith on "Canada and Great Britain."

IV.—Applied Art Section.

At the first meeting of the Section on December 15th, 1903, Mr. Frank Warner read a paper on "The British Silk Industry," which contained a full account of its decay since 1860, and suggestions as to the best means for reviving it. A brilliant collection of furniture silks was exhibited on the walls of the Meeting-room. At the second meeting, Mr. George Coffey, in dealing with "Celtic Ornament," chiefly confined himself to the consideration of the scroll pattern, and illustrated his subject by lantern slides of fine examples, dating from the 3rd century, B.C., which had been found between the Danube and the West Coast of Europe. Mr. Alan Cole, C.B., in his paper on "Recent Developments in Devonshire Lace-making," drew attention to the public action which was being taken in Devonshire for the improvement of the teaching of the art of designing, and showed photographs of some of the specimens sent to the St. Louis Exhibition. Mr. Alfred East, A.R.A., in his paper on "The Sentiment of Decoration," drew attention to the principles upon which decorative design should be founded, drawing distinctions between the classic, the naturalistic, and the emotional, and claiming that the decorative quality was as esssential to fine art as to applied art. In his paper on "Crystalline Glazes and their Application to the Decoration of Pottery," Mr. William Burton explained how in his own practice the chief difficulties connected with the use of these glazes had been overcome, and the erratic character of their flow been brought under control. The paper was illustrated by the exhibition of a fine collection of glazed pottery. The last paper of the session was by Mr. Arthur Lasenby Liberty on "Pewter and the Revival of its Use." In it the author, after giving a history of pewter, drew special attention to the attempts which had been made in England and in Germany to revive the use of this interesting metal. A large collection of specimens of old and modern pewter was shown. At the invitation of Mr. Carmichael Thomas, Treasurer of the Society, a visit was made on Thursday evening, February 18th, by the Applied Art Section, to the new printing offices of the *Graphic* newspaper in Tallis-street, Victoria Embankment. The newspapers were in course of production, and the whole process, from the composition of the type and the preparation of the illustrations, was shown and explained to the visitors, who highly appreciated the completeness and beauty of the arrangements.

V.—Cantor Lectures.

Five courses of Cantor Lectures were delivered during the session. The first of these by Mr. Bennett H. Brough on "The Mining of Non-Metallic Minerals," was supplementary to the course on "The Nature and Yield of Metalliferous Deposits," which he gave in 1899. The minerals treated included coal, which was dealt with very briefly, as it has already been the subject of previous lectures, bitumens, such salts as nitrates and phosphates, stones, together with clays, gypsum, asbestos, &c., and precious stones. The second course was by Professor J. Lewkowitsch on "Oil and Fats." The treatment included the supply of the various fats, animal and vegetable, and their manufacture, also their numerous applications for food, paints, varnishes, linoleum, candles, soap, &c. The third was a short course by Mr. Charles T. Jacobi on "Modern Book Printing," in which the character of modern type was dealt with, and the style and character of modern typography. The important subject of "Electro-Chemistry" formed the subject of the fourth course by Mr. Bertram Blount. This course may be looked upon as a continuation of the course delivered by Mr. James Swinburne, in 1896, and dealt entirely with recent work in electro-chemistry. In addi-

tion to the methods of electrolytic refining and winning of metals, both in aqueous solution and from fused electrolytes, Mr. Blount described the methods applicable for obtaining electro-chemically such non-metallic products as alkali and bleach, chlorates, baryta, nitric acid, &c. The last lecture was devoted to the electric furnace and its products, such as calcium carbide, carborundum, phosphorus, &c. This lecture was illustrated by experiments on what was practically a manufacturing scale, for a large electric furnace was built up in the meeting-room, and practial demonstrations were given of the production by its means of calcium carbide and carborundum. The fifth course was by Professor Langton Douglas on "The Majolica and Glazed Earthenware of Tuscany." The lecturer, in tracing the history of this famous artistic earthenware, brought to bear on his subject the result of much original research among the Italian archives. In the first lecture he pointed out that the prominent position held for a time by Siena in the production of the ware. In the second lecture a full account was given of the family of Della Robbia and the majolica of Florence. Montalupo and Cafaggiola, and the smaller fabbriche of Tuscany were dealt with in the third lecture.

VI.—Juvenile Lectures.

The Juvenile Lectures this year were delivered by Mr. Eric Stuart Bruce, the subject being "The Navigation of the Air." As usual, the course consisted of two lectures, the first being devoted to balloons and parachutes, the second to airships, kites, and flying machines. A short historical sketch of the progress of ballooning was given, and special reference made to the use of balloons in war. An account of the airships of Santos Dumont, Severo, Spencer, and Lebaudy was also given, also of the flying machines depending on aeroplanes, such as those proposed by Sir Hiram Maxim and Professor Langley. The use of kites for scientific investigation was also described.

VII.—Albert Medal.

The Albert Medal for the present year has been awarded, with the approval of His Royal Highness the Prince of Wales, President of the Society, to Mr. Walter Crane, "in recognition of the services he has rendered to Art and Industry, by awakening popular interest in Decorative Art and Craftsmanship and by promoting the recognition of English Art in the forms most material to the commercial prosperity of the country."

Mr. Crane's reputation as a decorative designer stands very high in his own country but it stands even higher on the Continent of Europe and in America, where his work has met with the fullest appreciation. His writings on decorative art have had a very great influence in the revival of that branch of the arts, while the establishment, greatly due to Mr. Crane and Mr. Lewis F. Day, of the Art Workers' Guild and the Arts and Crafts Exhibition Society, have largely aided to secure for the industrial arts of the United Kingdom that public recognition as a department of art which has long been wanted. Mr. Crane's work as a decorative designer has not only secured wide popularity, but has received the approbation of those best qualified to appreciate it.

The Council have long felt that while the claims of Applied Science have been fully recognised in the awards of the Albert Medal, those of the application of art to industry have never received the recognition they deserved, and it has been a matter of regret not only to the members of the present Council, but to their predecessors, that there is only a single name (Sir Henry Doulton) on the long list of the recipients of the Albert Medal to whom the medal has been given for services rendered to the application of art to industry. They are, therefore, specially gratified that His Royal Highness, the President of the Society, has ratified their award of the medal on the present occasion to Mr. Walter Crane.

VIII.—Medals.

Amongst the readers of papers during the past Session there were several Members of the Council, and, according to the usual practice, medals were not awarded for such papers. These are (in the Ordinary Meetings):—Sir William H. Preece, who read a paper on "The Science of Taxation and Business," and Mr. H. H. S. Cunynghame on "Furnaces suitable for Jewellers' Work, Enamelling, Art Casting, and other similar Industries;" also (in the Indian Section) Sir William Lee-Warner, on "The Presidency of Bombay," and Sir Thomas H. Holdich, on "Our Commercial Relations with Afghanistan." The Council have had pleasure in acknowledging the merit of all these papers

by passing a vote of thanks to their authors.

It was decided last year that no medal should be awarded to readers of papers who had previously received medals from the Society. Acting on this rule the Council were precluded from considering the following papers:—In the Ordinary Meetings, the paper by Professor C. V. Boys on "Thermit;" in the Indian Section, the paper by Mr. A. G. Stanton on "British-Grown Tea;" in the Colonial Section, the paper by Sir John A. Cockburn on "The Biology of Federation;" and in the Applied Art Section, the papers by Mr. William Burton on "Crystalline Glazes," and by Mr. Lasenby Liberty on "Pewter." All these papers the Council consider to be of considerable merit and well worthy the distinction of a medal.

The following are the awards:—

At the Ordinary Meetings:—

Sir Charles Malcolm Kennedy, K.C.M.G., C.B., "The Fiscal Problem."

Arthur Gulston, "Ice Breakers and their Services."

Robert Jones, M.D., B.S., M.R.C.P., F.R.C.S., "Physical and Mental Degeneration."

J. C. Medd, "Agricultural Education."

Thomas Tyrer, F.I.C., F.C.S., "The Need of Duty-free Spirit for Industrial Purposes."

William Pollard Digby, "Statistics of the World's Iron and Steel Industries."

Richard R. Holmes, C.V.O., "Early Painting in Miniature."

In the Indian Section:—

J. M. Maclean, "India's Place in an Imperial Federation."

Frank Birdwood, B.A., "China Grass: its Past, Present, and Future."

In the Colonial Section:—

Lady Lugard (Miss Flora L. Shaw), "Nigeria."

Alfred Emmott, M.P., "Cotton Growing in the British Empire."

In the Applied Art Section:—

Frank Warner, "The British Silk Industry."

Alfred East, A.R.A., "The Sentiment of Decoration."

Alan S Cole, C.B., "Recent Developments in Devonshire Lace-making."

IX.—Swiney Prize.

In accordance with the provisions of the will of Dr. George Swiney, the prize bearing his name was duly awarded in January last, on the sixtieth anniversary of the testator's death. Dr. Swiney died in 1844, and in his will he left the sum of £5,000 Consols to the Society of Arts, for the purpose of presenting a prize, every fifth anniversary of his death, to the author of the best published work on Jurisprudence. The prize is a cup, value £100, and money to the same amount; the award is made jointly by the Society of Arts and the College of Physicians.

A meeting of the adjudicators of the prize was held on Wednesday, January 20, 1899. The Lord Chief Justice, G.C.M.G., Vice-President of the Society, was in the chair.

The adjudicators received a report from the joint Committee of the Society of Arts and the College of Physicians, recommending that the prize should be awarded to Sir Frederick Pollock and Mr. F. W. Maitland, for their book, "History of English Law before Edward the First," and in accordance with the recommendation adjudged the prize for the work mentioned.

The cup hitherto awarded was designed, in 1849, for the first award by D. Maclise, R.A., but on the present occasion a cup was presented to each of the joint authors, and it was therefore necessary to make certain modifications in the original design. The required alterations were successfully carried out by Messrs. Garrard, to whom the preparation of the cup has always been entrusted.*

X.—Owen Jones Prizes.

After the death, in 1874, of Owen Jones, a committee was formed to collect subscriptions for the purpose of founding a memorial. The money thus obtained was partly expended in erecting a monument over his grave in Kensal Green, and the balance (a sum of £400) was presented to the Council of the Society of Arts upon condition of their expending the interest thereof in prizes to "Students of the Schools of Art who, in actual competition, produce the best designs for Household Furniture, Carpets, Wall-papers and Hangings, Damask, Chintzes, &c., regulated by the principles laid down by Owen Jones." The prizes have now been awarded annually since the year 1878 on the results of the annual competition of the Board of Education.

Six prizes were awarded this Session, each prize consisting, in accordance with the regulations laid down for the administration of

* A list of the previous recipients will be found in the *Journal* for October 16, 1903 (vol. 51, p. 893).

the Trust, of a bound copy of Owen Jones's "Principles of Design," and a Bronze Medal.

The list of the successful candidates has already appeared in the *Journal*.*

The next award will be made this summer, on the result of the present year's examinations. Six prizes have again been offered for competition.

XI.—Mulready Prize.

Under the terms of the Mulready Trust, a Gold Medal, or a Prize of £20, was offered for competition among students of the Schools of Art in the United Kingdom at the annual competition for the present year. The prize was to be given to the student who obtained the highest awards in certain subjects—all life studies, and was awarded to Thomas Corrie Derrick, of the Queen's-road School of Art, Bristol, who obtained the mark "Excellent."

This prize is presented occasionally, as the accumulated funds permit, to the student who exhibits the best drawing from the nude at the annual examinations of the Board of Education. It has been awarded on several previous occasions, the last being in 1897.

XII.—Fire Prevention Prizes.

At the request of the Executive Committee of the International Fire Prevention Exhibition held in London last year, the Council of the Society offered, out of the funds of the Fothergill Trust, certain gold, silver, and bronze medals, for the best chemical fire engines and for the most easily worked long ladders exhibited at the International Fire Prevention Exhibition at Earl's-court.

This Trust arose out of a bequest by Dr. Fothergill, in 1821, "for the establishment of premiums for promoting useful arts." The objects which the testator proposed to the Society for consideration all related to the prevention of fire, and the Council have therefore considered it desirable to retain the connection of the Trust with fire prevention, although the bequest was not really limited to this special purpose. On the report of judges appointed by the Executive of the Exhibition, one gold, three silver, and two bronze medals were duly awarded. The names of the recipients will be found in the *Journal* for October 16, 1903.

* See *Journal*, vol. 50, p. 819, September 11, 1903.

XIII.—North London Exhibition Trust.

It was stated in the Report of the Council for 1902-3 that prizes amounting to fourteen guineas had been offered to students in the art classes of the Northampton Institute, Clerkenwell.

The money for these prizes was provided by the accumulation of interest on an invested capital of £157 presented to the Society of Arts in 1865 by the Committee of the North London Working Classes and Industrial Exhibition (1864). This amount was the balance of the surplus from that exhibition, and it was given with a view to the award annually of prizes for the best specimens of skilled workmanship exhibited at the Art Workmanship Competitions of the Society of Arts. The Art Workmanship Competitions were discontinued after 1870, and it has since been rather difficult to know how the funds arising from the Trust could be disposed of in a manner which might accord with the intention of the donors. In 1884 the Society awarded certain prizes in connection with the Inventious Exhibition, and among these was one (a gold medal or £20) offered under the Trust in question for the best set of specimens illustrating the handicraft teaching in any school. In 1896 an amount of £22 odd was awarded in prizes at the East London Exhibition, held in that year. In 1902 there was again a small accumulated capital, and the Council considered that a very proper way of disposing of it would be to offer it in art workmanship prizes for students connected with that part of the metropolis where the North London Exhibition was held.

The prizes were duly awarded last November, and the offer has been renewed for the present year.

XIV.—Prize for a Dust-Arresting Respirator.

In July last an announcement was made that the Council were prepared to award, under the terms of the Benjamin Shaw Trust, a Prize of a Gold Medal, or Twenty Pounds, for the best Dust-Arresting Respirator for use in dusty processes, and in dangerous trades.

As far back as 1822 the Society awarded its Gold Medal to Mr. J. H. Abraham, of Sheffield, for a Magnetic Guard to protect persons employed in dry grinding. The apparatus described in the Society's "Transactions"* includes a Respirator to cover the mouth and nose. This Respirator was fitted

* Vol. 40, 1822, page 135.

with magnets, for the purpose of arresting the fine particles of steel thrown off in the process of pointing needles, and in other processes of dry grinding. Although the invention was greatly appreciated at the time, it appears never to have come into practical use, the main objection to it having been, it is believed, raised by the workpeople themselves, who feared that the lessened risk attached to their employment would lower their wages. Similar considerations have, it is believed, stood in the way of the introduction of various appliances intended to limit the risks associated with all trades in which the workpeople breathe a dusty atmosphere. It was, however, thought that such considerations are likely to have less weight at the present time, and it was hoped that the offer of a prize might draw the attention of inventors to the matter, and might result in the production of some suitable piece of apparatus, despite the difficulties with which the solution of the problem is surrounded.

By the end of December, the date fixed for their reception, 60 different inventors had sent in apparatus. Of these 27 came from the United Kingdom, and 33 from other countries, viz., United States of America (9), Germany (6), Austria (6), France (3), India (2), Italy (2), Norway (2), Holland (1), Canada (1), Tasmania (1).

The Committee has held numerous sittings and have examined all the appliances sent in. A large number they have been able to reject as unsuitable or impracticable, but they have selected a certain number for further examination and test, and on these they hope to be able to report before very long.

XV.—Prizes for Drawing.

Since 1899, the Council have placed at the disposal of the Royal Drawing Society, for competition among the candidates at its annual examination, 12 Bronze Medals, and, as usual, these medals were awarded for drawings sent in by students to the exhibition held by the Drawing Society in April last.

XVI.—Examinations.

The number of students who enter for the Society's examinations still continues to Increase. The total number of candidates in March last was 21,570, an increase of 2,155 on last year. These entries were—in the ordinary grade 13,709, and in the elementary grade 7,861. As the working out of the results for the present year is not yet completed it is not possible to say exactly how many of these candidates presented themselves, but the numbers are—Grade II. 11,368, and Grade I. about 6,447, the total being approximately 17,815. The actual number of papers worked was in Grade II. 12,610, and in Grade I. 7,203. In addition to those candidates who were examined in commercial subjects and in music, 438 candidates were examined viva voce in modern languages, and 514 in the practice of music. The total number of candidates who were examined in all subjects by the Society of Arts during the year just completed is therefore 18,767.

The following Table shows the general results in Grade II. for the last twelve years:—

Year.	No. of Candidates.	No. of Papers worked.	No of Centres.	No. of Subjects.
1893........	3 702	3,916	109	13
1894........	4,106	4,376	131	14
1895........	4,777	5,108	146	14
1896........	6,111	6,568	197	16
1897........	6,919	7,513	221	19
1898........	7,636	8,372	243	19
1899........	8,750	9,581	260	23
1900........	8,894	9,808	267	23
1901........	8,797	9,669	276	17
1902........	9 020	9,967	289	17
1903	10,616	11,670	322	17
1904........	11,368	12,610	324	17

The following Table shows the percentage of those who, during the past four years, have obtained First, Second, or Third-class certificates, or have failed:—

Years.	1st.	2nd.	3rd.	Fail.
1901	11	22·2	40·3	26·5
1902	13·5	27	34	25·5
1903	14	23·9	39·8	22·3
1904	13·4	28·7	33·9	24

It is not perhaps wise to lay too much stress on these percentage calculations, but so far as they can be trusted, the percentages for this year seem to indicate that the standard, which has shown in previous recent years a tendency to rise, has, if anything, fallen a little during the present year, and indicates that the rapid growth in numbers has not been accompanied by a similar increase in the quality of the candidates. This year it will be noticed that the percentage of First-class candidates is a little smaller than last year—13·4 against 14, while the percentage of

failures is a little higher—24 against 22·3. On the other hand the percentages of all classes correspond very closely in the years 1902 and 1904.

The increase in numbers is spread over nearly all the list of subjects, in fact there are only three which show a falling off—English, 258 against 260; German, 318 against 327; and Portuguese, 29 against 40. It will be noted that even in these the diminution is very slight. On the other hand several subjects show a considerable increase. In Book-keeping there is an increase of 356 on last year, in Shorthand one of 225, and in Typewriting one of 171. The following are the numbers in the other subjects:—French 805 and 770, Arithmetic 345 and 285, Commercial Geography 98 and 89, Economics 79 and 77, Précis-writing 106 and 75, Italian 38 and 10, Spanish 174 and 171, Russian 11 and 5, Danish 2 and 1.

In Book-keeping, the largest subject, the Examiners report that the general result is not quite so good as last year, for though the First-class percentage is practically the same, 21·35, the Second-class has slightly decreased, and the Third-class increased. The failures are slightly less than last year.

In Typewriting, the most noticeable feature in this year's examination is the marked increase in the number of first and Second-class certificates, and the decrease in the number of failures. The percentage of First-class candidates this year is 9·48, whereas last year it was 5·26; the percentage of failures this year being only 16·09 compared with 22·80 last year.

The work in Commercial History and Geography is stated to have reached a higher standard than that of last year. The Examiners in the modern language subjects, and in the other subjects, do not note any special characteristics in the work of the present year; but, on the whole, speak favourably of it as compared with that of previous years.

The precise number of candidates for Grade I. cannot yet be stated; approximately it is 6,447, but the number of papers worked shows a considerable increase on last year, when there were 6,020; in the present year there were 7,203. The number in 1902 was 4,807.

In all the subjects except Arithmetic and German there is an increase. Book-keeping is still the most popular subject, and it is also the subject which shows the largest increase, as there were 601 candidates more than last year. Shorthand, the next largest subject, shows an increase over last year of 177. The numbers in the other subjects are:—Typewriting 914 and 732, Handwriting and Correspondence 371 and 366, Arithmetic 577 and 584, Geography 132 and 68, French 828 and 660, German 252 and 284. Spanish was added this year and 25 candidates took it up.

The following Table shows the number of candidates who passed or failed in each subject:—

Subjects.	No. of papers worked.	Passed.	Failed.
1. Handwriting & Correspondence	371	175	196
2. Shorthand......	1,819	977	842
3. Book-keeping ..	2,285	1,422	863
4. Commercial Arithmetic ..	577	369	208
5. Commercial Geography ..	132	69	63
6. French	828	512	316
7. German	252	191	61
8. Spanish	25	18	7
9. Typewriting	914	686	228
Totals	7,203	4,419	2,784

The examinations in Music were held as usual simultaneously with and under the same conditions as those in commercial subjects. This year 500 candidates entered, 327 in Rudiments of Music and 173 in Harmony, showing an increase of 37 over last year, when there were 463. The work, however, was not quite so good, for though the proportion of failures, 111 and 101 respectively, is only a little larger, the proportion of higher certificates awarded is considerably less, 115 and 126.

In response to an application from the Council, the Board of Education permitted their inspectors to visit a number of the examination centres while the examinations were being held. It was not possible to arrange that all the centres should be visited, but a great many, both in London and the provinces, were thus inspected.

The reports received from the Inspectors justify the statement that in nearly all cases the examinations were properly conducted. In a few cases, the arrangements made were reported as not being entirely satisfactory, but in no case were the Inspectors able to detect any serious breach of the regulations, or any important deficiency, and in no case was there any evidence of fraud or collusion having been practised. The Council cannot but regard this as a high testimony of the manner in which the examinations are conducted by the voluntary Committees who undertake this work,

and they desire to express their high appreciation of the assistance which the Board of Education, and His Majesty's Inspectors under the Board, have rendered to the Society.

The Council regret to have to mention that in one particular instance the Examiner detected evidence of collusion among the candidates at a certain centre, and the result of an inspection of the papers convinced the Council that there must have been grave negligence in the manner in which the examination was superintended. Very much, therefore, to their regret they felt themselves compelled to refuse to accept the examination at that centre. Although from time to time solitary instances of copying are detected and dealt with—and in so large a number of candidates it would be strange if this were not the case—it is very rare that instances of such very lax supervision have been detected, and the Council feel that they are fully justified in the reliance which they place on the Local Committees generally, and upon their officials.

XVII.—Examinations, 1905.

Considerable alterations will be made in the general system of examinations next year, though it is not intended that their character or their general standard shall be in any way affected. For some years past suggestions have been made from various quarters to the Council that it would be desirable to establish a higher grade of examination, which might be taken by more advanced students than those now entering for the present examinations. The Council gave very careful consideration to the proposal, and they decided that any considerable change ought not to be made in the system before the opinions of those chiefly interested in the examinations were obtained. They, therefore, in October last issued a circular to the Secretaries of the Local Committees asking for their opinion as to the desirability of the formation of a senior grade of a distinctly higher character than the present examination; at the same time suggesting an alternative, namely, the elevation of the present standard, and the formation of the existing First-class and Second-class into a Senior Grade, the present Third-class into an Intermediate Grade, while the present Grade I. might form, as now, a Junior or Elementary Grade. In putting forward this alternative proposal, the Council were greatly influenced by a desire not in any way to depreciate the value of the existing certificates, of which a very large number are of course now in existence. How large this number is may be estimated from the fact that over 75,000 certificates have been issued by the Society during the past ten years.

In response to this circular, the Council received a large number of answers. The opinions expressed varied considerably—a large number were opposed to any alteration in the existing system; some were in favour of a new and distinctly higher grade examination; but the great preponderance of opinion was in favour of the second suggestion. The Council therefore have determined, in accordance with the recommendations of the Examinations Committee, that the examinations shall in future be arranged in the following divisions:—

1. Elementary.—Corresponding to the present Grade I.

2. Intermediate. — Corresponding to the present Grade II. Third-class and lower part of the Second-class.

3. Advanced.—Corresponding to the present Grade II. First-class with the upper part of the Second-class.

The Advanced and Intermediate stages will each be divided into two classes. The Elementary stage will be of one class only. Separate papers will be set for each stage.

For the present year it is not proposed that any alteration should be made in the existing standards; but it is probable that in future years the standard for the Advanced stage may be very gradually raised. No elevation of the standard for the Intermediate or the Elementary stage is contemplated.

The following new subjects will be added for the Advanced stage:—(*a.*) Commercial Law, (*b.*) Accountancy and Banking. The other subjects for both Advanced and Intermediate stages will be the same as those in which examinations are already held, namely: (1) Arithmetic, (2) English, (3) Book-keeping, (4) Commercial History and Geography, (5) Shorthand, (6) Typewriting, (7) Economics, (8) Précis-writing, (9) French, (10) German, (11) Italian, (12) Spanish, (13) Portuguese, (14) Russian, (15) Danish, (16) Chinese, (17) Japanese. Hindustani will also be added in both stages.

For the Elementary examinations the subjects will remain as now for Grade I., namely:—(1) Handwriting and Correspondence, (2) Shorthand (3) Elementary Book-keeping, (4) Commercial Arithmetic, (5) Commercial Geography, (6) Preliminary French, (7) Preliminary German, (8) Preliminary

Spanish, (9) Preliminary Italian, (10) Elements of Typewriting.

The fees will remain the same as at present —2s. 6d. for each subject in the Advanced and Intermediate Stages, and 2s. for the Elementary Stage, with a reduction to 1s. for every subject after the first subject taken up.

The Council have not contemplated without some reluctance any alterations in a system which has now worked so extremely successfully for a large number of years, but they believe the changes proposed are on the whole such as will commend themselves to all concerned, while they trust that they will not involve any additional difficulty in the regular and efficient conduct of the examinations.

XVIII.—Viva Voce Examinations in Modern Languages.

These examinations, which were established two years ago, continue to prove useful and attractive. Up to the present date 12 examinations have been held this year in London and in Manchester. Arrangements have also been made for holding examinations at several other centres.

At these examinations 271 candidates presented themselves, of whom 192 passed (31 with distinction) and 79 failed. The languages taken up were as last year, French, German, Spanish, and Portuguese. Italian has been added, but as yet no examination has been held in that language.*

In 1902, 280 candidates were examined in all, of whom 202 passed and 78 failed. In 1903 there were 455 candidates of whom 320 passed and 135 failed.

These examinations are held at any of the Society's centres where the necessary arrangements can be made. They are held at any date convenient to the local committee. The examination includes dictation, reading, and conversation, and the examination is so arranged as to test efficiency in a colloquial knowledge of the language, without laying too much stress on minute grammatical accuracy. Candidates who are reported upon as highly qualified by the examiners, receive a certicate of having passed with distinction.

The examiners are Mr. E. L. Naftel for French, Professor H. G. Atkins for German, Professor Ramirez for Spanish, and Mr. J. d'Oliveria e Silva for Portuguese.

* A Table giving details of the result was published in the *Journal*, of the 2,th June, vol. lii., p. 667.

XIX.—Practical Examinations in Music, 1903.

The practical examinations in Music for 1903 were not concluded until too late for the results to be concluded in the last Report of the Council.

The examination was conducted by Mr. Ernest Walker, M.A., Mus.Doc.Oxon., and Mr. Burnham Horner.

The system of examination was the same as that for recent years. For instrumental music certain standards are given, and candidates are asked to select for themselves which of these standards they choose to be examined in. The standards range from easy to very difficult music. For each standard a list of music is given for study, and from this list candidates select the pieces they will perform. Candidates are expected to play or sing the pieces which they have prepared, to play or sing a piece, or portion of a piece, at sight, and to play certain scales.

In all, 501 candidates entered, and of these 486 were examined, an increase of 89 as compared with the previous year; 8 of these took up two subjects, so that there were 494 examinations. Of these there were 418 passes and 76 failures.

The following were the subjects taken up:—Piano, singing, violin, violoncello, viola, and organ. 408 entered for the piano, 347 of whom passed; 60 entered for the violin, of whom 49 passed; 2 entered for the violoncello, both of whom passed; 3 entered and passed for the organ; 20 entered for singing, of whom 16 passed; 1 entered and passed for the viola. No medals were awarded.

The tests were, perhaps, slightly severer than heretofore, so as to give greater value to the certificates.

XX.—Practical Examinations in Music, 1904.

The Practical Examinations for the present year have not yet been concluded. They commenced on Monday, June 20th. They will be finished about July 8th, after which a summary of the results will be given in the *Journal*. The work of the examination is being carried out by the same examiners as in the last two years. 576 candidates have entered for the present examinations, an increase on last year of 78. This is the greatest number of entries yet received for these Examinations, the previous highest being 566 candidates in 1901.

XXI.—Chadwick Trust.

Under the provisions of the will of the late Sir Edwin Chadwick, the Society of Arts has to nominate a member of the Trust established by Sir Edwin for certain purposes connected with sanitary education and the advancement of sanitary science. The Trust was formed in 1896, and Sir Douglas Galton was appointed to represent the Society of Arts. Since the death of Sir Douglas Galton in 1899, Mr. R. Brudenell Carter has acted as the Society's representative, but Mr. Brudenell Carter having resigned his membership of the Society, it became necessary to make a fresh appointment. In March last, the Council therefore nominated their Chairman, Sir William Abney, to represent the Society of Arts on the Trust.

XXII.—Leather for Bookbinding.

It was stated in the last Report of the Council that the Committee on Leather for Bookbinding had in view the issue of an extended and revised edition of their original report, and that in the preparation of this work the Society was promised the assistance of the Worshipful Company of Leathersellers. It was hoped that the book might have been published before the present date, but the amount of work has proved greater than was anticipated, and its preparation is not yet complete. A number of coloured illustrations showing the effect of light and other injurious agencies upon leather have been prepared, and a number of other illustrations have also been got ready. The text of the book is also far advanced, and the Council trust that it may be completed and published without much further delay.

XXIII.—Photogravure Exhibition.

In December last the Board of Education informed the Council that they proposed to hold another exhibition, to comprise the remainder of the scheme suggested by the Council to the Board in 1902, and that the exhibition would include photogravure and other photographic processes, including printing in colours. This portion of the scheme—it was originally proposed that it should be included with engraving—had been reserved by the Board for a separate exhibition. In accordance with a request of the Board, the Council had pleasure in suggesting the names of an Advisory Committee, and this committee has since been at work in the organisation of an exhibition, which it is proposed shall be opened about October next, and will consist of examples of process engraving in monochrome and colour.

XXIV.—Journal Indexes.

In 1902, the 50th volume of the *Journal* was completed. The indexes for the 10 yearly volumes—Nos. 41 to 50—have now been amalgamated, and will shortly be issued as the fifth 10-Volume Index to the Society's *Journal*. As soon as the printing is complete, notice will be given in the *Journal*, and members desiring a copy of the index can have it on application. The four 10-volume indexes for the first 40 volumes of the *Journal* are all in print, and can be supplied to any members who require them.

XXV.—New Council.

The Vice-Presidents retiring are Sir Benjamin Baker, Sir Edward Birkbeck, Mr. Michael Carteighe, Mr. H. Graham Harris, and the Hon. Richard C. Parsons. In their places the Council propose for election—Mr. Robert Kaye Gray and Mr. Alexander Siemens, who have been for some time Members of Council, and also Sir James Blyth, Lord Curzon of Kedleston, and Sir Charles A. Hartley. Lord Curzon was a Vice-President of the Society in 1896-7-8, but neither of the other two gentlemen have previously served on the Council in any capacity.

The Ordinary Members of Council retiring are Sir Alexander Binnie, Sir Robert Giffen, Mr. Robert Kaye Gray, and Mr. Alexander Siemens. In their places the Council nominnate Sir Gilbert Parker, M.P., the Hon. Matthew White Ridley, M.P., Dr. Boverton Redwood, and Professor J. M. Thomson, F.R.S. Professor Thomson was on the Council from 1896 to 1900, but the other three gentlemen have not held office before.

XXVI.—Conversazione.

The Society's annual Conversazione was held on Monday, the 27th inst., for the fourth time at the gardens of the Royal Botanic Society, which were placed at the disposition of the Society of Arts by its Council. As in previous years the entertainment was very successful, and was much enjoyed by the members, who attended in large numbers with their friends. An account of the Conversazione will appear in the number of the *Journal* containing this report.* The arrangements were of the usual character.

* See p. 675.

XXVII.—OBITUARY.

Amongst the losses by death which the Society has to deplore, certainly the greatest is that of Sir Frederick Bramwell. No one of the members took a keener interest on the welfare of the Society, no one devoted himself with a more constant ardour to its service. Since 1875 he served almost continuously on the Council as Member, Treasurer, Vice-President, and Chairman of Council, and in 1901 he held the Presidency of the Society during the interval between the accession of His Majesty and the assumption of the office of President by H.R.H. the Prince of Wales.

Another Member of Council who has passed away during the past year was Sir Clement Le Neve Foster. As the son of a former Secretary of the Society, he had long been closely associated with it, and even before he became a member, he was a frequent attendant at the meetings. Sir Edward Braddon, who died in Tasmania in February last, was a Member of Council from 1892 to 1894, and read several papers before the Society. Mr. James S. Forbes, the well-known Chairman of the London, Chatham and Dover Railway, was a Vice-President of the Society from 1889 to 1891. Sir Charles Nicholson, who was elected in 1863, was a Member of the Council in 1876.

Another very distinguished member of the Society was Sir Henry M. Stanley, who was elected a life member in 1878 by the Council "in consideration of the services to Commerce by his explorations in Africa." On several occasions he presided at meetings of the Society, and took part in its discussions.

Professor William H. Corfield had been a member of the Society since 1877, and in 1879 he delivered a very valuable course of Cantor lectures on "The Sanitation of Dwelling-houses." Sir John Scott, formerly Judicial Adviser to the Khedive of Egypt, and afterwards Deputy Judge Advocate General, read two papers before the Indian Section on the results of his work in Egypt.

Amongst other members of the Society, of whom notices have appeared in the columns of the *Journal*, are Admiral Boys, Mr. Charles J. Galloway, the Right Hon. C. Seale Hayne, M.P., and Mr. Samson Fox.

XXVIII.—FINANCE.

The annual statement of receipts and expenditure was published—in accordance with the usual practice—in the *Journal* last week. It shows the revenue and expenditure for the financial year ending May 31st last, the Assets and Liabilities of the Society, its Investments and the Trusts standing in its name.

The CHAIRMAN moved the adoption of the Report which was seconded by

Major-General Sir OWEN TUDOR BURNE, G.C.I.E., K.C.S.I., who said that the Report showed the steady and satisfactory progress which the Society had made during the past year. It was specially gratifying to see the increase in the number of candidates entering for the examinations, as it showed how very much the action of the Society in carrying on these examinations in commercial education was appreciated by the public at large. He also thought that the lectures and papers this year had reached a very high standard. He thought that the *Journal* had become, not only in this country, but in India, the Colonies, and elsewhere, one of the most valued of periodicals, as it contained papers by the best authorities on subjects of the greatest importance. He referred to the losses by death which had taken place during the year, and said how greatly the Society missed those who left its ranks year by year, especially was this so in the case of the late Sir Frederick Bramwell, who was always ready and willing to take part in the work of the Society.

Sir GEORGE BIRDWOOD, K.C.I.E., C.S.I., M.D., in referring to the award of the Albert Medal on a former occasion for services rendered to the application of art to industry, said that Sir Henry Doulton had rendered extremely valuable services by the development of artistic pottery, having carried on the work, at no profit to himself, out of his sheer love of art. With regard to the addition of Hindustani to the subjects of examination, he did not think that much educational value could be attached to this language, as it was easily learnt and easily forgotten.

Mr. WILLIAM MARTIN WOOD agreed with all that Sir Owen Burne had said as to the general excellence and high value of the papers which had been read during the past session. He was sorry to see the Society had not given any attention to a question of enormous national importance, viz., water transit within Great Britain. It was deplorable to see the stagnation in this country, compared with the great interest taken in this method of transit on the Continent. During recent years, the mileage of inland navigation in France had increased tens of thousand miles, whilst in this country it had decreased. He attributed the difference and disinclination of this country to railway interests, and thought the Society, as it was superior to any bias and was not to be deterred by powerful interests, should take up the matter seriously. As regards the examinations, he always looked upon them as a means of bringing the Society directly in touch with the provinces. Another

suggestion he had to make was that the reading-room of the Society might be thrown open to outsiders upon payment of a small sum, so that young men who could not afford to join the Society might have access to all the scientific publications in the Society's library. He also thought that the Council should consider whether it was not possible to arrange for a graduated scale of life composition fees, so that members who had been annual subscribers for a good many years might be able to compound at a lower rate than at present.

Sir GEORGE BIRDWOOD, K.C.I.E., C.S.I., asked if Mr. Martin Wood would suggest to the Council the name of a recognised authority on canals and inland navigation who would be willing to favour the Society with a paper on the subject. He did not think the idea of throwing open the reading-room to outsiders was likely to meet with much success.

The CHAIRMAN mentioned that several papers had been read before the Society on the subject of canals, but he felt sure the Council would welcome suitable papers dealing with the question. With regard to Mr. Martin Wood's suggestion about allowing outsiders the use of the reading-room, he did not think that such an arrangement was practicable, but he would undertake to bring the matter before the Council.

The adoption of the report was then agreed to.

The CHAIRMAN moved a cordial vote of thanks to Sir Henry Trueman Wood (the Secretary), Mr. Henry B. Wheatley (the Assistant Secretary), and the other officers of the Society, which was carried unanimously.

The SECRETARY returned thanks for this expression of confidence in himself and in the other officers of the Society.

The CHAIRMAN referred to the Photogravure Exhibition to be held at the Victoria and Albert Museum this year, and said that it was the outcome of a movement on the part of the Society of Arts. If it had not been for the Society none of this series of exhibitions would have been held, nor could the Board of Education have carried them on satisfactorily. He also mentioned that, as Chairman of the Society of Arts, he had been appointed Chairman of the Committee to organise the exhibition.

The ballot having remained open for one hour, and the Scrutineers having reported, the CHAIRMAN declared that the following had been elected to fill the several offices. The names in *italics* are those of members who have not, during the past year, filled the office to which they have been elected.

PRESIDENT.

H.R.H. the Prince of Wales, K.G.

VICE-PRESIDENTS.

H.R.H. the Duke of Connaught and Strathearn, K.G.
Duke of Abercorn, K.G., C.B.
Sir William Abney, K.C.B., D.C.L., D.Sc., F.R.S.
The Lord Chief Justice, G.C.M.G.
Sir George Birdwood, K.C.I.E., C.S.I., M.D., LL.D.
Sir James Blyth, Bart.
Major-Gen. Sir Owen Tudor Burne, G.C.I.E., K.C.S.I.
Lord Curzon of Kedleston, G.M.S.I., G.M.I.E.
Lewis Foreman Day
Sir James Dewar, LL.D., F.R.S.
Hon. Sir Charles W. Fremantle, K.C.B.
Robert Kaye Gray
The Lord Chancellor
Sir Charles Augustus Hartley, K.C.M.G., M.Inst.C.E.
Lord Kelvin, O.M., G.C.V.O., D.C.L., LL.D., F.R.S.
Sir William Lee-Warner, K.C.S.I.
Sir William Henry Preece, K.C.B., F.R.S.
Sir Walter S. Prideaux
Lord Rothschild
Sir Marcus Samuel, Bart.
Alexander Siemens
Sir John Wolfe-Barry, K.C.B., F.R.S.

ORDINARY MEMBERS OF COUNCIL.

Sir Steuart Colvin Bayley, K.C.S.I., C.I.E.
Sir Mancherjee Merwanjee Bhownaggree, K.C.I.E., M.P.
William Bousfield, M.A.
Henry Hardinge Samuel Cunynghame, C.B.
Francis Elgar, LL.D., F.R.S.
Lieut.-Col. H. C. L. Holden, R.A., F.R.S.
Colonel Sir Thomas Hungerford Holdich, R.E., K.C.M.G., K.C.I.E., C.B.
Sir Gilbert Parker, D.C.L., M.P.
Sir Westby B. Perceval, K.C.M.G.
Boverton Redwood, D.Sc.
Hon. Matthew White Ridley, M.P.
Professor John Millar Thomson, LL.D., F.R.S.

TREASURERS.

Sir Owen Roberts, M.A., D.C.L., F.S.A.
Carmichael Thomas

SECRETARY.

Sir Henry Trueman Wood, M.A.

On the motion of the CHAIRMAN, seconded by Mr. MARTIN WOOD, a vote of thanks to the Scrutineers was carried unanimously.

Colonel Sir THOMAS HUNGERFORD HOLDICH, R.E., K.C.M.G., K.C.I.E., C.B., proposed a vote of thanks to the Chairman for his services in presiding at the meeting, and also as Chairman of Council during the past year.

The motion was seconded by Mr. ROBERT KAYE GRAY, and carried unanimously.

The CHAIRMAN acknowledged the vote of thanks.

The meeting then adjourned.

Notes on Books.

THE OIL FIELDS OF RUSSIA, by A. Beeby Thompson. London: Crosby Lockwood and Son, 1904.

The "Region of the Eternal Fire" was the attractive title chosen by the late Charles Marvin, in 1884, for an admirable descriptive account of the industry dealt with in the volume now under review. Mr. Marvin was an exceptionally intelligent and observant traveller, and to his natural gifts was added the trained capacity of the journalist for recording his impressions in a lucid and interesting manner. This work supplied much accurate information on technical questions which might have been supposed to be beyond the grasp of a man who was admittedly not an expert in petroleum.

Since the date mentioned, the petroleum industry of Russia has been somewhat fully described in "Petroleum and its Products," by Dr. Boverton Redwood (to whom the author expresses his acknowledgments) and in various other treatises on the general subject of petroleum, whilst the geology of the oil-bearing districts, the chemical nature of the oil, the methods of drilling the wells, the processes of refining, and the systems of distributing the commercial products have all been more or less minutely treated of in contributions to current scientific literature.

Mr. A. Beeby Thompson's work is, however, the first to be devoted solely to the furnishing in a collective form "of information of a practical nature concerning the Russian oil fields," and it may be conceded that the great importance of the industry which contributes about one-half of the world's supplies of petroleum products affords ample justification for its publication. "The Oil Fields of Russia" may be described briefly as a successful attempt to present the engineering features of the industry in such detail as to furnish a guide to those who are engaged in the practical development, management, or control of oil properties in Russia. The first three chapters are mainly devoted to introductory and explanatory remarks, and to an account of the geological conditions under which the oil occurs, the author in dealing with the geological branch of the subject having had the benefit of his father's assistance. In the fourth chapter an account is given of the principal Russian oil fields, and the succeeding seven chapters are devoted to engineering details of the drilling and working of petroleum wells according to the methods which experience has shown to be best adapted to the local conditions. Chap 12 deals with the generation of steam for use in t various operations, chapter 13 with the subject liquid fuel, chapter 14 with fires on the oil fields, a chapter 15 with the administration of oil properti

There are three appendixes giving statistics of t industry reproduced from recognised sources, a other information useful for reference. The technic descriptions are lucidly written, and it is evident th the author not only knows what ought to be state but has taken the pains to express himself in readab English. The book is well illustrated, and contai a coloured map of the principal oil fields. It is al printed in excellent type on good paper, and forms handsome volume of 500 pages.

This review would not be complete without a fe words of warning as to the use which may be mad of the work. As a guide to those who are intereste in the Russian oil fields "The Oil Fields of Russia should prove of considerable value; but it is needf to point out that every oil field is *sui generis*; an although a careful study of the practice adopted in given district may furnish suggestive information t the intelligent and thoughtful expert engaged i similar work elsewhere, it would be disastrous if i were assumed that certain methods of procedur which furnish good results under special condition are equally applicable in other cases where the con ditions are essentially different.

BRITISH INDUSTRIES: a Series of General Review for Business Men and Students. Edited by W J. Ashley. London: Longman, Green and Co.

This volume contains the lectures delivered befor the University of Birmingham, which were designed for two classes of auditors; as the editor says they were intended to supplement the instruction given by the permanent teachers to the students in the Faculty of Commerce, and it was hoped that they would also prove interesting and suggestive to men already in business. The editor points out that one lecturer sometimes differs from another in his opinion on a particular topic, and he holds that these divergences ought to set the student thinking. The subjects of the lectures are—The British Iron and Steel Industries, by Stephen S. Jeans; the Midland Iron and Steel Wages Board, by Daniel Jones; the British Cotton Industry, by Elijah Helm; the Woollen and Worsted Industries of Yorkshire, by F. Hooper; the British Linen and Flax Industry, by Sir R. Lloyd Patterson; British Railways as Business Enterprises, by C. H. Grinling; British Shipping, by B. W. Ginsburg; and the Trust Movement in Great Britain, by H. W. Macrosty.

THE LIFE, WORK, AND INFLUENCE OF ROBERT ADAM AND HIS BROTHERS. By John Swarbrick. London: Hazell, Watson and Viney.

In this Prize Essay of the Architectural Association, the author gives an account of the work of the Brothers Adam, and its influence on English art, with a bibliography of the subject.

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FRIDAY, JULY 8, 1904.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

CHAIRMANSHIP OF COUNCIL.

On Monday, 4th inst., at their first meeting, the Council elected Sir William Abney, K.C.B., D.C.L., F.R.S., as Chairman for the ensuing year.

The various Committees were also re-appointed.

EXAMINATIONS.

The results of this year's Examinations (Grade II.) will be published to-morrow (Saturday).

The Grade I. results will be issued about the end of the month.

APPLIED ART SECTION COMMITTEE.

A meeting of the Committee of the Applied Art Section was held on Tuesday afternoon, 5th inst. Present:—Sir George Birdwood, K.C.I.E., C.S.I., in the chair; Cyril Davenport, Lewis F. Day, the Hon. Sir Charles W. Fremantle, K.C.B., Halsey Ricardo, Alexander Siemens, and Carmichael Thomas, with Henry B. Wheatley, Secretary of the Section. The arrangements for next Session were considered.

INDIAN SECTION COMMITTEE.

A meeting of the Committee of the Indian Section was held on Wednesday afternoon, 6th inst. Present: — Sir William Lee-Warner, K.C.S.I., in the chair; Sir George Birdwood, K.C.I.E., C.S.I., F. C. Danvers, T. W. Holderness, C.S.I., Colonel Sir Thomas Holdich, R.E., K.C.M.G., K.C.I.E., C.B., General Michael, C.S.I., Sir Patrick Playfair, C.I.E., J. D. Rees, C.I.E., and Alexander Rogers, with Sir Henry Trueman Wood, Secretary of the Society, and S. Digby, Secretary of the Section. The arrangements for next Session were considered.

SECOND REPORT UPON THE ZEBRA DOMESTICATION EXPERIMENTS AT MORENDAT, BRITISH EAST AFRICA.

[The Society of Arts have been favoured with permission to publish the following Report to the Secretary of State for Foreign Affairs, by R. J. Stordy, M.R.C.V.S., Veterinary Officer, H.M. East Africa and Uganda Protectorates, with the accompanying illustrations. The first Report was printed in the number of the *Journal* for July 10, 1903, vol. 51, p. 691.]

In continuation of the report which was forwarded to His Majesty's Principal Secretary of State for Foreign Affairs through Sir Charles Eliot, K.C.M.G., C.B., His Majesty's Commissioner for the East Africa Protectorate, in March, 1903, I have the honour to make the following further report on the experiments connected with the domestication of the zebra.

It was quite apparent that the captured zebras were members of four distinct herds, and for a short period these herds remained separate. As the result of so many animals feeding in such a circumscribed area as the boma was—the grass, owing to its being consumed and trodden down by the zebra which were constantly in motion by day and night, soon became very meagre. When this took place, grass had to be cut and brought in to the animals from without, and spread in a long line inside the boma to be consumed by them, which was done thrice daily. This had the immediate effect of bringing the members of the different herds together. At first it was noticed that only the stallions came to feed, the mares, more particularly with those in foal or with foal at foot, remaining aloof. This aloofness, however, did not last long, as in a very few days they also joined the stallions and fed upon the grass which had been brought in. It was quite obvious that the exclusiveness of the separate herds had not even then been broken through, as numerous attacks were made by members of one herd upon those of another—stallions attacking stallions, and mares viciously biting and kicking members of their own sex. In these onsets the foal frequently came between the combatants with the inevitable result that they were severely mauled, and in several cases their injuries proved fatal.

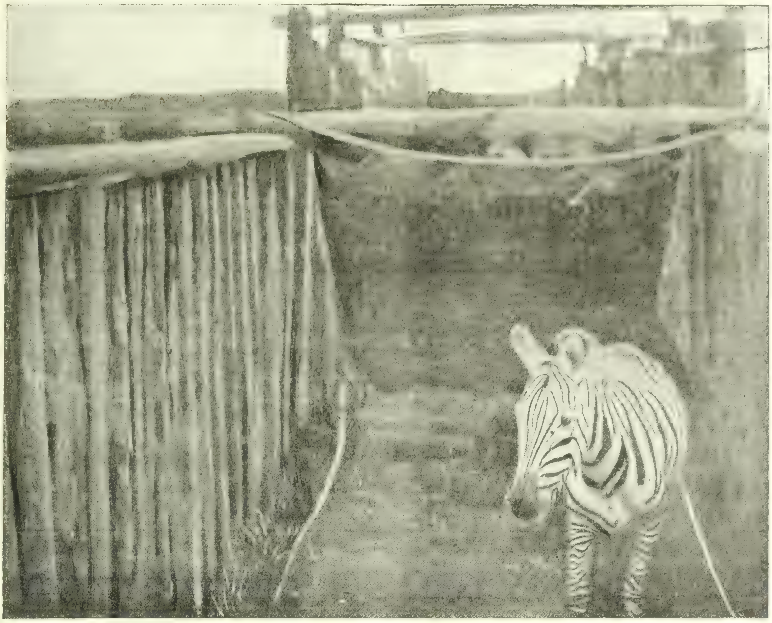
FIG. 1.

ZEBRA SIX WEEKS AFTER CAPTURE, SHOWING HOW CLOSE THEY APPROACH THE CAMERA.

FIG. 2.

ZEBRA SEPARATED FROM OTHERS—WITHIN THE ALLEY.

FIG. 3.



ZEBRA ENTICED BEYOND FALLING DOOR—DOOR FALLING.

FIG. 4.

ZEBRA LEAVING CATCHING-BOX.

FIG. 5.

ZEBRA LEAVING CATCHING-BOX AFTER BEING HALTERED — SHOWING ADJUSTMENT OF NECK AND ROPE HALTER.

FIG. 6.

The animals became so familiarised to the ttendants bringing in the cut grass and to he frequency and regularity in which this was one that upon 2nd April, 1903, five weeks fter their capture, several of the stallions fed om the hands of the natives and about a eek later it was quite possible for a white an to approach them. This action of the tallions was soon followed by that of the nares, but even to this date, it cannot be said hat the mares are quite free from suspicion.

To prevent as far as possible the fighting mong the zebras and also to facilitate the andling of the respective sexes, kraals were uilt within the boma. This was effected by first of all dividing the boma into two portions by means of juniper posts built across he boma and subdividing the portion on the orth side of the boma. Within one of these kraals the stallions were confined.

The next step was to endeavour to handle the animals individually, as this was absolutely necessary for the successful carrying out of the domesticating experiments. First of all, an alley one hundred yards long and eight feet wide was constructed on the boundary between the two kraals, each side of the alley forming a boundary for the respective kraals and each end of the alley was closed. A door opened from the kraal occupied by the stallions into is alley. Cut grass was introduced and the stallions very soon found their way in to eat the grass.

At the further end of the alley a "catching-box" was built. This was twelve yards long of the same breadth as the alley, and the sides were eight feet high. At the end of this box, towards the alley, a falling door was hung. The normal position of this door was horizontal, but it was so constructed as to fall to a perpendicular position, the lower edge being about two feet off the ground. Further, this door could be slid along towards the blind end of the box. Between the entrance to the alley and the catching-box was another door (a folding door) opening and shutting in the usual way, and so constructed as when closed to form a compartment separate from the remainder of the alley. The *modus operandi* of catching an individual zebra was thus rendered easy, and this was as follows:—

A few zebras were got into the alley to feed. The entrance door from the kraal was then shut and the animals confined within the alley. The next operation was to get a single zebra into the catching-box. What was done was that, when a zebra by chance separated itself from the others and wandered in the direction of the catching-box past the folding door, this door was closed behind it. The zebra was now within a compartment by itself. It was then enticed or driven towards the blind

FIG. 7.

end. After passing under the falling door, a signal was given and the latter door fell, with the result that the zebra was enclosed within a very small space. It was quite an easy matter after this to get the zebra into practically a narrow stall by running the sliding door upon him. The blind end of the catching-box, its sides and the falling door, were all padded to prevent the animal injuring itself. The difficulty then arose how to halter the zebra. A

the first zebra. Having been successfully haltered, the falling door was again lifted allowing the zebra to get back into the alley whence it was led into the open. Stalls had been erected some distance from the alley and to one of these the haltered zebra was conducted. All the zebra captured were dealt with in this way, and the natives became so proficient in the operation that a wild zebra could be separated in the alley, confined in the

FIG. 8.

neck rope was first of all adjusted and placed over the animal's head. Its ears were gripped by native attendants and a halter slipped over its nose and fastened over the throat with a choke band. This operation required courage and dexterity, as the zebra is exceptionally vicious, and once having laid hold with its mouth it is nearly impossible to get it to quit its hold. The loss of a thumb by one of the Somali attendants was attributable to this cause; it occurred upon the capture of

catching-box, haltered and conducted to the open within three and a half minutes. The date of the haltering of the first zebra was the 19th June, 1903. In the case of mares with foals at foot, spaces, sufficiently large to allow the young animals to pass through, were made in the sides of the alley. By this means the foals could be separated from the larger animals, and were thus prevented from being crushed or trampled upon in the separating operations.

It was soon discovered that the zebras did not take kindly to the stalls, as several of them ran back, and were brought up by the halter with such violence that in two cases dislocation of the neck took place. It was therefore found necessary to construct small boxes (12 ft. by 9 ft.) for primarily familiarising them with their confined quarters ; this proved quite successful. After this initial stage they were brought into the stalls, having become accustomed by this time to a halter. No time was lost in halter-breaking them, the animals being led about daily and taken down to the river to drink. This is a reversal of the wild zebra's nature, as they only drink at night time. The temperament of the stalled animals was very varied, for while some permitted themselves to be groomed, others resented this interference. In course of time, some of them were found to be so tame that the placing of a saddle upon them was a comparatively easy matter, and ultimately the harnessing of some of them to vehicles was found to be practicable. From first to last the time occupied in arriving at this result may be stated to be about eight months, although some of the animals were ridden within five months. To prove that a certain amount of domesticity had been acquired, it may be interesting to note that a zebra which had broken away from its attendant about three and a-half miles from the zebra ranch retraced its steps to the boma, and went straight to its stall. The success of the experiment was not without its disappointments. Towards the end of May, 1903, several of the zebra died suddenly, and upon making *post-mortem* examination, I discovered the presence of the worm *strongylus tetracanthus* in the bowels and the *strongylus armatus* in the arteries, which had been the cause of death in every case. These two parasites account for the mortality which subsequently took place among the animals. The ravages of the parasites were increased by the phenomenally heavy rains experienced during the months of May, June, and July, and were in part attributable to the smallness of the area, which had become infected. For the success of further experiments, I would suggest the enclosing of a much larger area, probably two or three miles square, this would entail an expenditure of about £1,000. Shelters were erected in different parts of the boma to protect the zebra from the heavy rains with, I hope, fairly satisfactory results. Drugs were, in addition, administered, and were, in many cases, taken by the animals without serious opposition and proved efficacious. In addition, it was thought advisable to see whether a change of food would be beneficial. Accordingly, a number of the animals were tethered outside the boma and allowed to graze at will with, I trust, good results.

It may be interesting to note that the presence of the zebra within the enclosure has in no way attracted their natural enemies, viz., lions, leopards, and other carnivorous animals.

Acting on instructions received from Sir Charles Eliot, I forwarded in December 1903 to India, for the use of the Indian Government, four zebra stallions which had been broken in at Morendat. I personally accompanied them from Naivasha to Mombasa and saw them shipped. Their condition was all that could be desired, and their behaviour in transit compared very favourably with that of the horse. I believe that the stallions are to be used by the Indian Government for the production of hybrids, which it is hoped will be of great service for military purposes. The natives, particularly the Swahilis, and Wakikuyu proved themselves wonderfully capable of managing the zebra, both in its wild and domesticated states, and I have great pleasure in recording this fact.

Much of the success of the experiments is attributable to Mr. J. T. Peffers, my assistant, whose services cannot be too highly spoken of.

In conclusion, I may be permitted to state that I am quite satisfied with the result hitherto achieved. Much has been learnt during the past year with regard to the zebra, its temperament and habits. As I formerly reported, it is my opinion that it is not so much to the wild animal, however much domesticated, that the ultimate success of the experiment is to be looked for, as rather to the progeny of the existing animals, and when the success which has attended our past efforts is borne in mind, I am confident that in the near future the zebra, which to-day is a wild animal, will be classed as one of our most useful beasts of burden.

Edinburgh, February 29, 1904.

Miscellaneous.

WEST INDIAN INDUSTRIES.

Sir Daniel Morris (Imperial Commissioner of Agriculture for the West Indies) recently gave an address on the "Agricultural Industries of the West Indies," at a meeting of the West India Committee, in Leadenhall-street. He said that there had been a general

impression that most of the land in the West Indies had already been taken up for cultivation, and that very little remained for the purposes of new industries. That was quite a mistake. Allowing for swamps, rocky and other useless land, it was probable that there still remained 2,000,000 acres suitable for bearing crops of some kind. The principal crops now grown were sugar-cane, cacao, coffee, fruit, limes, arrowroot, spices and cotton. Experiments in cotton-growing had been carried on during the last three years, and the result had been to show that the West Indies could produce as good cotton as the United States. The encouragement of this industry had received special attention from the Imperial Department of Agriculture. The area planted in 1902 was 400 acres, in 1903 4,000 acres, and during the present year sufficient seed had already been supplied by the Imperial Department of Agriculture to plant 8,000 acres. There were 15 cotton ginneries already established, and turning out cotton of high quality. He had arrived at the conclusion that the best variety to grow in the West Indies was sea island cotton. It was the best in the world, and it could not be grown anywhere except within the influence of sea air. Therefore, inland places like Georgia, Florida, and other parts of the United States could not grow it. The wider interest taken in the West Indies was regarded as having begun with the appointment of the West India Royal Commission of 1896, but more particularly with the carrying out of the recommendations of that Commission under the supreme direction of Mr. Chamberlain, to whom the Colonies generally owed a large debt of gratitude. Referring to the scientific work of the Imperial Department of Agriculture, which has its headquarters at Barbados, he said that the experiments in aid of the sugar industry were devoted to raising new varieties of canes for the purpose of increasing the yield of sugar per acre, and in obtaining canes of a disease-resisting character; also in testing the relative value of manures, and the most economical methods of cultivation, and the general treatment of cane plants. By means of the Imperial grants the experiments originally started at Barbados, British Guiana, and Antigua, had been extended and improved. The area planted in new seedling canes in British Guiana had steadily increased and now comprised about 13,000 acres. In Barbados and Antigua, owing to the occurrence of disease in the Bourbon cane, seedling and other canes were almost exclusively cultivated. The work of raising seedling canes was still, however, in the experimental stage, but it was full of promise. A factor of great importance in regard to the future of the sugar industry was the removal of the Continental sugar bounties, and everyone interested in the West Indies was grateful to Sir Nevile Lubbock, and those associated with him, for what they had done towards getting those bounties removed. There were hopes that the introduction of the Naudet system would lead to improved results being obtained from the sugar properties. The sugar industry was certainly in a better position than he had ever previously known it to be during the 25 years that he had been connected with the West Indies. Cacao, rice, fruit, and limes were amongst the most important industries next to sugar. The fruit industry of Jamaica was now worth nearly £1,000,000 per annum, and it had received a considerable impetus by the establishment of a direct line of steamships, thanks to the enterprise of Sir Alfred Jones, between that island and the United Kingdom. Having described the scheme of agricultural education in the West Indies, he said that it was out of the question that the work which the Imperial Department of Agriculture had been doing should be stopped. The way to ensure its being carried on, however, was for each colony to supplement the Imperial grants, and thereby show that they appreciated the sacrifices which the mother country was making to help them. Without a central authority in the West Indies he thought it impossible that any united action could take place with regard to any matter whatever. The time must arrive when, agriculturally, they must have, he would not say confederation, but united action.

INDIAN COTTON.

In view of the interest at present taken in the cultivation of cotton, and the efforts of the Association which has been formed to encourage the growth of it in various parts of the British Empire, the annexed statement showing the production of it in India, in quinquennial periods, during the past forty years, may be instructive, and dissipate the idea that that country "has fallen out of the race," as remarked by the Secretary for the Colonies in the recent debate in the House of Commons. Mr. Lyttelton doubtless meant the remark to apply to the requirements of Lancashire. If so, he was quite correct. England can no longer spin, with advantage, the short staple cotton of India, though the spinners on the Continent are still able to do so. But the bulk is now retained in India for use in her mills, while Japan is now by far the most important of her foreign buyers. In the first half of the past forty years the cotton crops in India averaged about two million bales; in the next ten increased to two and a-half millions; in the following five to nearly three millions, and in the last five to over three and a quarter million bales; while in the season ending in June last year the total brought into sight exceeded three and three-quarter million bales of 400 lbs. each. The only element of uncertainty in the statement is that relating to "local consumption" other than by the mills. In 1869 it was officially estimated at 600,000 bales; in 1891 at 413,000 bales, and more recently at 250,000 bales. Twenty years ago the Punjab Government placed the production of that Province at over 200,000 bales, and estimated the local consumption at 84 per cent., or say 185,000

bales. At that time there was not a mill in the Punjab: to-day, there are five, consuming about 21,000 bales yearly. I know of no reason yet advanced to account for any reduction. On the contrary, all my inquiries point to the local consumption in India exceeding 400,000 bales, or say half a pound per head, a very conservative estimate.

In the first decade of the last four, England's annual imports of Indian cotton exceeded a million and a quarter bales, or 64 per cent. of the crops, but in the past five years they have averaged but 66,000 bales, or two per cent. The opening of the Suez Canal was the death blow to her depôt trade with the Continent, the spinners of which at once commenced to increase their direct importations, till in less than a dozen years their annual purchases exceeded those of Lancashire spinners. Between 1889 and 1893 Continental requirements averaged over a million bales, England's, in the same period, dropping to 350,000 bales. After that period, while Lancashire's purchases fell off rapidly, those by the Continent decreased to three-quarters of a million bales. But last season, owing to short supplies in America—and for the same reason again this year—English spinners took over 100,000 bales, and the Continent more than $1\frac{1}{4}$ million bales. Comparing the last with the first quinquennial period, it will be seen that Europe secured but 24 per cent. against 67 per cent. of the available Indian supply in the two periods. Sixty to seventy years ago China and the Far East received from India fully 200,000 bales —more even than England—but during the war of Secession in America, the export trade to the Celestial Empire entirely ceased, and thereafter never approached these figures, as the returns in the statement show during the first three decades. The remarkable increase in the past dozen years or so, is due to the rapid expansion of the mill industry in Japan, the spindles of which use far more Indian than any other cotton. Two seasons ago her purchases approached 800,000 bales, but last year fell to 350,000 bales. While India's exports of cotton, in the period under review, fell 80,000 bales, her consumption—by mills and locally—rose last season to over two million bales, of which the mills required nearly 1,700,000 bales. The ratio of exports therefore fell from 71 to 41 per cent., while home requirements rose from 29 to 59 per cent.

A. F. BEAUFORT.

INDIAN COTTON CROPS.

In thousands of bales at 400 lbs. Years ending 30th June.

Quinquennial periods ending.	Exports to					Consumption.			Total Crop.
	U.K.	Continent of Europe.	Total. Europe.	Japan, China, &c.	Total.	Mills.	Local.	Total.	
1867–68	1,285	140	1,385	74	1,459	65	540	605	2,064
1872–73	1,243	230	1,473	94	1,567	114	495	609	2,176
1877–78	721	500	1,221	60	1,281	193	470	663	1,944
1882–83	454	753	1,207	90	1,297	355	440	799	2,096
1887–88	574	829	1,403	55	1,458	640	425	1,065	2,523
1892–93	349	1,063	1,412	88	1,500	1,061	418	1,479	2,479
1897–98	94	831	925	299	1,224	1,351	413	1,764	2,988
1902–03	66	742	808	573	1,381	1,589	250	1,839	3,220
							400	1,989	3,370
In 40 Years Increase	..	642	..	499	..	1,524	..	1,234	1,156
								1,384	1,306
In 40 Years Decrease	1,217	..	517	..	78	..	290	..	..
							140		
Percentage of crop. .. 1867–68	64·3	2·8	67·1	3·6	70·7	3·2	26·1	29·3	100·
1902–03 (a)	2·1	23·0	25·1	17·8	42·9	42·9	7·8	57·1	100·
1902–03 (b)	2·0	22·0	24·0	17·0	41·0	47·1	11·9	59·0	100·

(a) If crop be taken at 3,220,000 bales. (b) If crop be taken at 3,370,000 bales.

COMMERCIAL AND TECHNICAL SCHOOLS IN RUSSIA.

The Russian Minister of Finance reports that 149 commercial schools were opened in Russia between 1896 and 1903. Of these 147 are in existence at present. The majority of these schools were established without any subsidy on the part of the Government. At the beginning of 1903 there were in these 147 commercial schools, 2,180 teachers and 32,251 pupils. The schools are spread over the whole of the

country in an unequal manner. For all Siberia and the Central Asiatic Provinces there is only one, at Tomsk, whereas St. Petersburg and the adjoining region have 58. The Government has, however, appropriated a sufficient amount for the erection of a separate building for the Deep Sea Navigation School at Vladivostock. The city authorities have allotted a spacious piece of ground opposite the Naval Club for that purpose, have granted £1,030, and promise £310 annually, taxing merchant licenses 10 per cent. additional to make up this sum. The teaching of the Chinese language will be introduced in the Deep Sea Navigation School, and an official of the Navy Department, M. Mehailofsky, is to be the teacher. The Ministry of Finance has had charge of all commercial and some technical schools. There was, according to the United State Commercial Agent at Vladivostock, a plan to transfer all these to the Ministry of Education. Now they are to be placed under the control of the new Board of Commerce and Navigation. The report of the Habarofsk Technical Railway School for 1901-2, has recently been published. The school was established seven years ago. At the end of the last scholastic year, the number of scholars was 49, but the progress made by the young men was not very satisfactory, as their previous education had been defective. The course of studies commenced with seven hours work a day. The second class studied the work of locksmiths, and the third class that of blacksmiths. During the summer months the young men are occupied with carpentry work, surveying, and the erection of buildings. The graduates are obliged to stay in the employ of the local railways for practical work, from July 15th to September 10th. The total number of pupils for the seven years was only 58, and only 13 of them still remain in the employ of the railway, so that the chief aim of the school to provide efficient and experienced agents for technical work on the railways is evidently not yet realised. Some of the pupils enter into the employ of the Navy Department, where they get better pay than on the railway. The Russian Government is working on a project to organise a course of lectures for the training of agents for the railway systems. The special subjects of study will be the technical parts of trains in motion, commercial exploitation, the telegraph, book-keeping at the stations, keeping of records, and the administrative duties. The supplementary studies will comprise drawing statutes on railway law, knowledge of merchandise, theory in principles of railway tariffs, and elementary knowledge of electricity in its application to railways. In order to raise the level of general education among the *employés* on the Government railways, special evening schools are established at the stations. Forty-three applications, from different parts of Russia, have been received for the opening of commercial schools. Of this number, 13 came from the Warsaw district alone. The chief inspectors of schools in the Amur Provinces informed the Mayor of Vladivostock that, upon the solicitations of the general governor to have a technic school in that City, the Government at St. Petersbur ordered plans and estimates for the erection of suc a school to be prepared at a cost not exceedin £36,500, and that arrangements should be made t have the school opened some time during the ne five years. On November 30th last, a new buildin for a navigation school was opened at Odessa, whic cost £25,000.

General Notes.

Tea Cultivation in India.—Messrs. Barr and Co., Calcutta, report that the first sale of th season was held on May 20th, when 7,851 chest were disposed of at an average of 5as. 8p. per lb The average for the corresponding sale last yea when 5,674 chests were sold was 5as. 11p. per lb The audited accounts for 1903 of 64 joint stock te companies registered in Calcutta show profits aver aging 8·04 per cent. on a paid-up capital c Rs.21,263,835, and dividends to the extent of 4·2 paid to shareholders. Classified according to dis tricts, the dividends were: Assam, 2·40; Cacha and Sylhet, 4·67; Darjeeling, 3·42; and Dooars 7·63. Of the 64 companies 20 are in Darjeeling 17 in Cachar and Sylhet; 15 in Assam; and 12 i Dooars. In 1902 the dividends of the locally regis tered companies amounted to 2·05, and in 1901 to 1·41 In 1901 and 1902 such companies numbered 60, o four less than in 1903. There were 87 Calcutta regis tered companies in 1895; 89 in 1896; 79 in 1897 77 in 1898; 68 in 1899; and 75 in 1900. The approx imate cultivated area during the past eight years wa in acres as follows:—1896, 72,524; 1897, 62,059 1898, 63,089; 1899, 58,184; 1900, 63,904; 1901 50,921; 1902, 48,356; 1903, 53,233. The abov figures relate only to the tea companies formed i Bengal. One of the tables in Mr. Stanton's recen paper shows that, including the companies registere in the United Kingdom, the approximate area unde tea cultivation in India was in 1902 upwards of half a-million acres, the precise figures being 525,252.

MEETING FOR THE ENSUING WEEK.

Tuesday, July 12...Æronautical Society (at the House o the Society of Arts), John-street, Adelphi W.C., 8 p.m. 1. Mr. Charles Harding, "Scientific Balloon Ascents." 2. Prof. A. F. Zahm "The Measurement of Air Velocity and Pressure i Æro-Dynamic Experiments," and "The Balloo Anemometer." 3. Messrs. Eustace Short an Horace Short, "An Airtight Balloon Car for High Ascents."

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FRIDAY, JULY 15, 1904.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

TEN-VOLUME INDEX TO "JOURNAL."

The new Index to the *Journal* of the Society of Arts for volumes xli. to l. (1892-1902), is now ready, and can be obtained by members on application to the Secretary, John-street, Adelphi.

Some copies of the four previous Ten-volume Indexes are still in stock, and can also be obtained by members on application.

The price to non-members of each Index is half-a-crown.

COLONIAL SECTION COMMITTEE.

A meeting of the Committee of the Colonial Section was held on Wednesday afternoon, 13th inst. Present: Sir Westby B. Perceval, K.C.M.G., in the chair; Sir John Alexander Cockburn, K.C.M.G., and Mr. Alexander Siemens, with Mr. S. Digby, Secretary of the Section.

The arrangements for next session were considered.

CANTOR LECTURES.

MODERN BOOK-PRINTING.

By Charles T. Jacobi
(Of the Chiswick Press).

Lecture I.—Delivered 22nd February, 1904.

This initial lecture, treating of types, will naturally be somewhat introductory, but I think I can promise that the second and concluding one will be of greater interest, and embrace such variety as may be termed the more romantic side of printing—that is, it will consist of the several different stages that contribute to the making of a good book. In dealing with the subject of modern book-printing it is all-important that the question of type founts should be first considered, and this, too, at some length, for a good alphabet is the primary essential in all fine printing.

In order to do this satisfactorily, we must take a brief survey of those types which were used by some of the early printers—and which, if somewhat crude in their production, had the merit of being good in their design.

After this has been done, it will also be well to consider the type faces of those special founts employed by some of the private presses that sprang into existence during the last decade of the 19th century, commencing with that of the Kelmscott Press, founded by William Morris, in 1890, nearly all of which went back, with more or less success, to the early printers for their models. This I suggest in order to show that it is possible to design an alphabet which has some distinctive characteristic, and that, as a rule, without departing too much from the original or traditional form of letter—whether it be of the Roman or of the Gothic character.

The third and final section I propose to devote to those founts that may be purchased in the open market, and of which there is a good number. This I hope will show that there is no difficulty in obtaining a suitable kind adapted for bookwork—the acquirement being a matter of judicious selection, but subject to a regard to its precise employment in any particular volume—this being regulated by the class of work for which it is intended.

In doing this I cannot include all the various series of a suitable design offered by the different typefounders, for time will not permit of a reference to them, but I trust my suggestions will not be taken as invidious in specifying some kinds and omitting others that may be equally good. It is not necessary for any one printing-house to put into stock too many varieties—in fact it would be inadvisable to do so, for complications would ensue and result in the mixture of styles.

Before proceeding further I should like to observe that it is somewhat of an anomaly that the greater portion of the better class of book-printing during the past fifty years has been produced by the aid of either old-face or old style types. This circumstance goes to prove the superiority of those characters over those of the so-called modern face.

Until the nineties of the century just closed

one might roughly have classified all Roman types in use for book-printing into three grades, but since that period the characters that fell under the head of (*b*) "old styles" have been subject to many variations. These three classes were divided as follows, and for our purpose to-night it will be well to retain that order:

(*a*) The Old Face of Type

(*b*) Revived Old Style Face

(*c*) Modern Face of Type

These three examples now shown are given in large founts of equal sizes in body to emphasize the difference in the actual design and finish of the letters.

(*a*). The Old Face is occasionally used for book-work, generally of an antiquarian character, the old-fashioned long ſ being sometimes used in conjunction with certain ligatured letters. This series was designed and cut by William Caslon, of London, in the early part of the 18th century. It was closely modelled on the Dutch types used in the preceding century.

(*b*). The Revived Old Style is more generally used for book-work, as a glance at most modern books will show. This particular class of type was first designed and cut by Messrs. Miller and Richard, of Edinburgh, about the middle of the 19th century.

(*c*). The Modern Face is more in demand for newspapers, magazines, school-books, scientific works, pamphlets, and so forth. This class of type faces was mostly created in the first-half of the 19th century, and is the production of various founders.

It is necessary to say here that all reproductions of types shown on the screen are but exaggerations, and due allowance must be made for these enlargements which are apt somewhat to distort the true character of the letter. At the conclusion of the second lecture next week, I propose to have on the table in front of the platform various examples of modern types, both of the private presses and of those types that are to be obtained in the open market. These specimens may be inspected after the proceedings by anyone practically interested in the subject of typography.

Having said so much as preliminary, we will now consider the question of types as used in the 15th century.

All those who have studied the invention of printing have learned that the earliest printers had manuscripts before them as their models; therefore the invention of printing from moveable types was but the discovery of a new method of the art of copying, which had long been in existence. In printing there was a continuity of aim and method, and it was only the means employed that differed. The early printed books were often not distinguishable from manuscript, but when the new method was identified it was considered superior.

Printing types may be broadly divided into three classes as regards their character, viz., Gothic, Roman, and Italic. These three kinds of type were practically copies of contemporary manuscripts, and, each separate style being essentially a conventional one, any great departure from its own particular form would be considered unorthodox. The three varieties as now shown on the screen were all in vogue within the first fifty years of the invention of the art of printing, which took place in the middle of the 15th century.

The few foregoing words are partly quoted from "The Venetian Printing Press," a study by Mr. Horatio F. Brown, published in 1891 by J. C. Nimmo—and the slide now shown on the screen is a very fair representation in

This is a ſpecimen of Gothic

This is a ſpecimen of Roman

This is a ſpecimen of Italic

present-day types of the three different forms of alphabets that came into use when printing was first practised.

In order to confirm this statement I now propose to submit a reproduction of the first three books printed in these characters. The one now shown is that of a page of Gutenberg's forty-two line Bible, which is printed in the pointed kind of black-letter—not to be confused with the rounder Gothic character called "lettre de Somme," of a little later period.

I am taking it for granted that it was John Gutenberg, of Mayence, who printed this Bible, which is probably the first book with moveable types, cast from an adjustable mould —although this point is a debateable one. The date of this Bible is supposed to be 1455 —and as a book it is a splendid example of workmanship in all respects. This expression of opinion is confirmed by all those who

appreciate good printing, and who realise the very great difficulties under which Gutenberg and his assistants must have laboured.

The next picture represents a specimen taken from Jenson's Letters of Cicero, 1471, and is the generally accepted example of what a good Roman fount should be. Nicholas Jenson was of French nationality, and settled in Venice about 1470. It was on his Roman type that Morris and some others are supposed to have modelled their special founts, at the same time embodying various little modifications, or what were considered improvements, with more or less success. This class of type was termed "Roman," probably from the fact that Rome was its birthplace. Sweynheim and Pannartz, two German printers, who settled in Subiaco, near Rome, used types of that kind just prior to Jenson adopting the same character.

The third example is taken from Aldus Manutius, of Venice, who first designed and cut a fount of italic in 1501. This style was based on the Italian cursive handwriting, and it is generally supposed that Aldus took the handwriting of Petrarch as his model. It will be observed that the capitals are of the upright character—Roman in shape. Inclined capitals were first adopted by the son of Aldus.

A few other examples that may be shown here of well-known books printed with characteristic types are those of Peter Schoeffer, the son-in-law of Fust, who was Gutenberg's partner. This is a specimen from the Psalter of 1457, which was the first book with a printed date attached to it—thus proving its precise origin. The black-letter is not so pointed as that used by Gutenberg, which gradually gave way to the round Gothic.

This specimen is from Gunther Zainer, of Augsburg, and is a fairly good example of round Gothic of the transitory period just mentioned of Gothic to Roman.

The other two following are those of Ratdolt, of Venice, 1477—a good Roman, and one from Aldus, taken from his edition of the Poliphilus of 1499, before he designed his italic fount. This volume is celebrated for its handsome appearance—the type and woodcuts, of the graphic description, harmonising in all respects. In fact, the whole *format* of this volume was extremely well carried out from beginning to end. This may be considered the earliest ideal of an illustrated book direct from the press, without the aid of scribe or illuminator. On the other hand, Ratdolt must be credited with the honour of being really the first decorative printer on a large scale.

Previous to William Caslon commencing to cut types in 1720 or so, there were no type founders of any note in England except John Day, of the 16th century, and much of the type used in this country was obtained from Holland. One of the finest collections of Dutch founts now extant in England is that of the Fell types (Fig. 1, p. 706), still in use at the Oxford University Press, and by the kindness of the controller, Mr. Horace Hart, I am enabled to show a slide portraying a series of these faces. It was through the energy and generosity of Bishop Fell, in the 17th century, that these types were collected and presented to the University Press. If not mechanically well produced, these types have the merit of good design, and possess a certain quaintness which renders them suitable for a limited class of work.

I also submit a reproduction of a page from the specimen book of Messrs. Enschedé, of Haarlem, which has all the general characteristics of the Oxford Fell types.

This foundry is still carried on at the same place, and many of the old types are yet to be obtained. The introduction of the Caslon types in the early part of the 18th century displaced very largely the importation of Dutch types to England as it did later on to Scotland—we will notice this presently.

It is not every one—not even every printer—who appreciates the little differences which serve to make one fount of letters distinctive from another, and this picture admirably illustrates some of the little points—in fact the serif or finish of the letter goes a very long way to differentiate the appearance

H H H H

of any alphabet. First, we have the Sanserif, showing the bald and unadorned letter, which is interesting to compare with the long, flat and thin serif of the Bodoni or Baskerville style—a treatment that is somewhat dazzling to the eye and accentuates too greatly the difference between the thick and thin lines; besides, this serif was too delicate for general use, the fine lines being liable to break easily, or at least show too quickly signs of wear and tear.

That of the bracketed kind is in more general use now-a-days, and is a more serviceable character. The fourth, which is of the stubby or club-footed order, is also a good wearing design, but this style of treat-

ment is better applied to any fount containing capitals only, because the stubbiness gives a certain crudeness of finish to lower-case letters, although there are some exceptions to this opinion—I refer to any extreme treat-

ABCDEFGHIJKLMN

ment of the three kinds here classified, but a modification of either style is sometimes made with good effect. One explanation perhaps to account for this kind of short serif is that on going back to the days of caligraphy, we find that the Roman character first consisted of capitals only, and that lower-case letters are comparatively a modern innovation.

One other point interesting to mention at this stage is that of the so-called Arabic figures. How much more clearly do the old fashioned non-ranging figures stand out than

1 2 3 4 5 6 7 8 9 0

1 2 3 4 5 6 7 8 9 0

he modern ones that range both at top and bottom. For comparison, refer to any volume of a tabulated nature, and compare the two kinds where printed in a mass. Take for example a Railway Time Table—who has not been confused with the 3 and 8, or other figures when printed in the modern face?

The example now given of John Baskerville, of Birmingham, formerly a writing master, is from a somewhat small book of his production, but it will be observed that there is quite a distinct character in his type, which is more pronounced in other books of his printed with a larger type. The difference between the Roman and italic is to be particularly noted—the Roman being a fairly open or round design, whereas the italic is somewhat compressed, or condensed laterally.

Baskerville made other features in some of his work by the use of a good black ink, which he manufactured himself, and by the employment of white and well-pressed paper, which, however, imparted a somewhat dazzling effect to his work.

The work of Bodoni, the Italian printer, at the end of the 18th century, was an exaggeration on a large scale of that of Baskerville. That Bodoni could print well we all know, but the innovations he made in regard to type faces is not appreciated by the authorities on such subjects at the present day. The work of this printer very greatly influenced type fashions in the early part of the 19th century, and has left its mark to this day, as will be observed when one critically examines most printing executed in the so-called "modern face." Fortunately, however, other influences are beginning to prevail, and except for certain classes of work (newspapers or official requirements mostly) founts of a better standard are being employed for the bulk of book printing.

The credit is due to William Caslon for the betterment of English type-founding; and although he was not trained to that business, he was induced to undertake the cutting of a certain type for a special purpose. That being a success, he eventually designed and cut the series of old-faced types (Fig. 2) now exhibited on the screen. This series I believe was commenced about 1720, and it took a number of years to complete the various sizes. It was admitted all round that this series was an improvement on the Dutch types then so much in use here in England—not only in design but in finish. They immediately sprang into general use and continued so till the end of the 18th century, when other fashions prevailed. In fact, there seemed to be a great difference of opinion at the commencement of the 19th century as to what constituted a really good and readable type-face, and I am here demonstrating some of those fashions. Out of five kinds now shown I am of the decided opinion that that of William Caslon is by far the best character.

Although Caslon's types were superseded and laid dormant for nearly half-a-century, there has been quite a demand for them during the past ten years. The Chiswick Press had very largely employed them during the second half of the 19th century for special work, and it is probably owing to the success of the Kelmscott Press that they have been more generally adopted — not only in this country but also in America.

Another series of ancient founts is that of the Marr Typefounding Company (Fig. 3). These types also belong to the 18th century, and emanated from a Glasgow Foundry that was carried on by Dr. Alexander Wilson, and eventually acquired by Dr. Marr in the middle of the 19th century. This firm had branch establishments in Edinburgh, London and Dublin. These types have been revived somewhat in recent years, especially by some of the Scotch printing houses, and are a slight variation from those of William Caslon, the principal feature being that they are rather thinner in general design. Dr. Wilson did for

Scotland what Caslon did for England, and they may both be termed "protectionists" of the right kind of "type," if the suggestion will be excused.

Something must be said here as to the special founts employed by the private presses that came into existence during the past 14 years or so, commencing with that of the Kelmscott Press. William Morris, in adding printing to his many other accomplishments, accentuated very much the efforts of the late Charles Whittingham in the early forties. In fact, Morris's efforts, it must be confessed, have left even a wider mark in the annals of typography when we consider the impetus that has been given to book-printing during the past few years. If his effects were gained by means which cannot readily be employed by the ordinary printer, his work has certainly stirred up the spirit of emulation, and one sees signs all round of an improvement in book production—just as his influence was observed in other directions—in decoration and kindred subjects.

In submitting some examples of those presses I am now only referring to the actual types employed, and next week I hope to have something to say as to the *format*, printing and paper adopted by these presses.

The slide now shown is that of the Golden type (Fig. 4), which is admittedly inspired by Jenson's Roman. Morris gave it sundry characteristics, which rendered it distinctive from any other type produced by the ordinary type-founder. One distinction being that although it was a Roman design, there was a very slight suspicion of Gothic in its treatment. This fount in time has been copied with some slight variation, but the details generally are not so good.

Morris's Troy type is of the round Gothic order, and was designed by himself, it is said, without reference to earlier printers, although it is not unlike that of Gunther Zainer, of Augsburg, who, as already noted, printed in the latter part of the 15th century. The smaller type of the same character, termed the "Chaucer," was practically, but not mathematically, a reduction of the Troy fount. Here again we have a successful attempt at revivifying in a general way the old form of letter with certain modifications, and adapted for modern usage. That these two types are eminently readable cannot be denied. It is also said that Morris himself preferred this character to that of the Golden, as being the more legible.

The fount designed by the Vale Press was of the Roman order too, and, like the Golden fount, was apparently based on the same early master of printing. I sometimes think it was a pity that there was not more distinction between this fount and that of Morris's. True there is a difference, but not sufficient, in my judgment, to make it equally meritorious with that of the Kelmscott Press Golden fount.

To my mind the most distinguished fount is that of the Doves' Press (Fig. 5) which is engaged at present in printing the Bible, of which two volumes out of five have now been issued. This type is remarkably clear and readable, and, at the same time, is quite devoid of any of what may be termed eccentricities of design. It is especially well cut, and the justification and finish of the letters are admirable. Here again reference has been made to the early printing of Venice for the basis of this fount.

Mr. C. H. St. John Hornby has also succeeded in designing a special fount based on that used by the two German printers, Sweynheim and Pannartz, who printed at Subiaco, near Rome, in the second half of the 15th century. The character here is of a semi-Gothic character, with a very strong touch of the Roman, and is peculiarly appropriate for the Dante for which it was first used. Perhaps a more exact description would be that it partakes more of the Roman, with a dash of the Gothic in its design, but this latter feature is more marked than in Morris's Golden type.

That employed by Mr. Ashbee at the Essex House Press is quite unique in its inception, although all may not care for the general design. Apart from this, I must say that the general effect of the printed page is good as presented in King Edward VII.'s Book of Common Prayer, just issued. In other respects too, the volume was well produced, especially the presswork.

It was in the forties of the 19th century that Mr. Charles Whittingham persuaded the firm of Caslon to cast for him a special fount of the original Great Primer Old Face type of William Caslon—which the Chiswick Press employed in the printing of Lady Willoughby's Diary. This was a work of fiction written in the style of the seventeenth century. This book immediately attracted attention, and as a result it somewhat over-ruled the taste for the so-called modern-faced founts that had been in use in the early part of that century. Still, for general printing, Caslon's face was considered somewhat too archaic, and only adapted for certain

classes of printing. This expression of opinion induced Messrs. Miller and Richard, of Edinburgh, to commence cutting their series of revived old-style faces (Fig. 6), and, as mentioned before, it is no exaggeration to state that the greater bulk of the better kind of bookwork was printed in the latter half of the 19th century in this style of face—if not of that firm's, in types of similar character produced by other founders, but all based on the same lines. These founts of other foundries are so numerous, that there is not time to specify them singly.

As mentioned before, the work of William Morris created yet another revival, and we have now a larger choice of book founts suitable for good printing.

Another old-style character of Messrs. Miller and Richard is the No. 4 series (Fig. 7) which is practically a reproduction, though somewhat heavier in face, of their original revived old style. This newer kind is essentially a readable type, and one I would like to see employed more generally. The chief point is that it carries more ink in printing and thus gives strength and boldness to the page.

One other series of what may be termed old modern-faced types (Fig. 8) is that which has been recently resuscitated by the same firm, and used largely by Scotch printers. These types have the point of being both clear and readable, and have quite a distinct character. Unfortunately the series is not a complete one, and the connection or harmony between some of the faces is not always consistent. Still, as modern-faced types they possess many advantages over the more recently issued so-called "modern-face," and have been used with good effect by some printing houses.

The Ronaldson Old Style (Fig. 9) is really of American origin, and may be recommended. It may be obtained here in England of Messrs. Charles Reed and Sons. There is a good distinctive feature in this series which, however, I do not altogether appreciate. In expressing this opinion I refer to the somewhat spikey finish of the letters which may not be displeasing to some tastes, and if so it may be considered as a serviceable series—the little point just commented on is certainly carried out consistently in all sizes, of which there are a good many.

The Antique Roman of Messrs. Stephenson, Blake and Co. (Fig. 10) is another series of types suitable for those desiring a good, strong character. This series was palpably influenced by Morris's Golden type, for certain few letters, both capitals and lower-case, are cut in imitation of the little characteristics which serve to make the Golden type distinct and separate from all other founts of type. Originally this "antique roman" was of a series that may be termed the "Clarendon" order. By the conversion of a few letters and casting the whole fount on a thinner body, so that the letters would stand more closely together, a

Some of the Roman Types mentioned in this Lecture.

Fig. 1. This is Oxford Fell type on Pica body.
2. This is Caslon's Old Face type on Pica body.
3. This is Marr's Ancient face of type on Pica body.
4. This is Morris' Golden type on English body.
5. This is the Doves' type on a Two-line Brevier body.
6. This is the Revived Old Style face of type on Pica body.
7. This is the No. 4 Old Style face of type on Pica body.
8. This is the old-modern face of type on Pica body.
9. This is the Ronaldson face of type on Pica body.
10. This is the Antique Roman face of type on Pica body.
11. This is the Cheltenham face of type on Pica body.
12. This is the Grasset face of type on Pica body.
13. This is the Flemish face of type on Pica body.

good all-round result was obtained. That it is vigorous in design and distinctly legible I think will be admitted.

The "Cheltenham" series (Fig. 11) just placed on the English market is another one of American design, and possesses features that certainly are of an exceptional kind. It will be noticed that the general character is that of a compressed or condensed fount. The letters individually are well carried out, but the long ascending strokes with short descending tails are the great features referred to. The idea is that the human eye in reading only takes in the upper part of the line, and that the lower portion is somewhat superfluous, hence the innovation. As an experiment I am demonstrating this theory on the screen. Whether this would work well in general practice I am not prepared to say; it is a matter for individual experiment, but that there is evidently something in the assertion must be apparent to those now looking at the screen.

The other founts are those termed the "Renner" and "Grasset" series. The former was designed by Mr. Theo. L. De Vinne, of New York, and based on the work of an early Venetian printer of that name. It has been principally used for the special productions of the Grolier Club. The fount called "Grasset" (Fig. 12) was designed by a present-day French artist, and may be obtained here in London of Messrs. John Haddon and Co. under the name of "Hugo." These founts have special features of their own, and may be used with good results for works requiring some distinction from the ordinary run of printing.

The Flemish old style (Fig. 13) is yet another series of book types recently introduced from Germany, and to be had here in London of Messrs. Shanks and Co. The capitals are good, very similar to those of the so-called French, but, being thickened, are bolder in character. The lower-case letters are somewhat condensed laterally, and if it were not for the difference in the various ascending and descending letters, the general effect would be much the same as that given by the Cheltenham series previously mentioned.

As a summary to the foregoing examples of types, it is a well-known fact that to design a new alphabet is an exceedingly difficult task, for one is very apt to stray into certain extravagances or eccentricities directly any attempt is made to depart from the conventional shape of the letter, and it is in this respect that some of the American type-founders have so lamentably failed. I give all due credit to our cousins across the water for being ahead of us in printing appliances, for in machinery we have certainly lagged behind them, but in matters of purely typographical design some proportion of their types—especially those of the commercial or jobbing character—are but caricatures of the original and accepted form of the alphabet. What can be more simple or more beautiful than the sets of old-French and

ABCDEFGHIJKLMNOP

ABCDEFGHIJKLMNOP

Caslon capitals now thrown on the screen, as compared with the slide that follows?

Perhaps a few words in regard to technical education may not be out of place before we separate for the evening. I think we all more or less deplore the lack of opportunity given to the present-day worker as compared with the past. This, of course, is largely due to the introduction of labour-saving machinery necessary for cheaper production. Through this circumstance a man's labour is more specialised, and unless he takes some steps to counteract what must be considered a drawback, he is apt to remain in one groove, and thus lose the chance of improving his position. This can only be remedied, in large firms especially, by the workman making a study of the principles that underly his trade, and he must also be prepared to sacrifice some of his leisure time in securing additional knowledge, by attendance at some technical class where the teaching given is on sound lines.

The handpress has performed prodigies in its time, but except for special or exceptional work, it has been almost superseded by the power press in most book-printing houses with any pretence to being up-to-date, whatever lingering affection there may be for old-time methods. As I have already said in other places, hand-work should really form the basis of a workman's education in his craft, but in producing work from a machine it is needful to exercise a careful discrimination in applying the traditional methods of hand-work to that capable of being produced by a machine. This is important, otherwise the results will be of a laboured character.

So much for press-work. The same remarks apply very much to the composing-room, since

in that department the work is even more subdivided; for beyond the mere picking up of types many men are thrown on the trade without further knowledge, even if ambitious to learn something more than what may be considered merely the rudiments of that particular branch. If the employer will not, or cannot, offer the opportunities needful for a wider knowledge, the individual must seek it for himself.

It is absolutely necessary that the workman should have some knowledge of the constituent properties or component parts of the materials which he handles. If he acquires this it will assist him very much in the larger appreciation of the other branches of his craft, and thus create a greater interest in his own particular section.

I have not, so far, said anything about the machine composition of types. Mechanical type-setting has reached us, and that it has "come to stay" is the opinion of all practical men. For newspaper work or magazine printing it answers admirably, but the time is hardly ripe yet for its general adoption in the setting-up of the better class of book-work. The two principal systems now more in vogue than any other are those of the Linotype and Monotype—and that these will in the future become more perfect for book-printing I have not the least doubt. Considering the very wonderful strides made in the improvement of the power-printing press in recent years, it is difficult to believe that mechanical composition has not proved more adaptable to general use. As it is, for the major part of book-work we still go on picking up types letter by letter, and building up line by line, till the page is completed, in precisely the same manner as the printers did some four and a half centuries ago. In this age of mechanical progress it seems hard to realise this as a substantial fact.

Lastly, we owe it to the legislation of recent years that our factories are a great improvement on those of the past. We may consider the regulations of the various Building Acts, as administered by the London County Council, as being somewhat irksome, but they are certainly beneficial to the employees, and, as a result, work is done under more favourable conditions than formerly. At one period any hole or corner was good enough for a printing office, but we have now in London, and in the provinces too, some of the finest buildings adapted for printing purposes. Apart from mere sanitary considerations, those of light, air, and warmth are very important elements in a printing office, and more so than in many other crafts. Without these essentials it wou[ld] not be possible to produce much of the wo[rk] coming under the head of "Modern Boo[k] Printing."

Correspondence.

BRITISH VERSUS FOREIGN PATENT LAWS.

The advantage accruing to an investor und[er] Patent-laws of the United States and Germany b[y] reason of investigation as to novelty prior to th[e] issuance of the patent, is that when the patent issu[es] the inventor or the owner therefore secures a gra[nt] which carries with it the presumption of novelty and which presumption requires proof to overcom[e] it or to invalidate the patent of the same charact[er] that is required to convict a man of murder, that i[s] it requires proof beyond a reasonable doubt. A grant sustaining such a legal presumption is of th[e] utmost value to inventors, in that the patent mean[s] something to the owner. It means that substanti[al] rights are secured thereby. The inventor or th[e] owner to whom the patent issues may use that gran[t] as the basis of his business, in case he should himsel[f] enter upon the manufacture of the patented device. It forms the basis by which he may negotiate wit[h] confidence for the sale of the patent, or of rights an[d] interests thereunder. No such presumption attache[s] to the issuance of a British patent. If a patente[e] takes his British patent to a manufacturer for th[e] purpose of interesting such manufacturer in th[e] patented device, either in the sale of the patent or o[f] some interest or right thereunder, there is no assurance, neither to the patentee or owner of th[e] patent, nor to the manufacturer, that there is anythin[g] in the patent which may be sustained or that may b[e] of value as a protection against infringers. It does not cover such a right as would justify a court i[n] issuing a *pendente lite* injunction. It does not carry with it the legal presumption of validity or o[f] patentable novelty, but only a mere colour of right. Mr. Abel seems to admit that the Patent-laws of the United States and Germany in this respect are good in theory. His greatest objection seems to be that he has found difficulty in securing the allowance o[f] applications for patents. In other words, apparently Mr. Abel admits that it is all right after the patents issue, but that the trouble of the United States and German patent systems is in the process of issuance of the patents; and he has stated with special reference to the laws of the United States certain main rules which he alleges have been laid down by the Examiners of the United States Patent-office as governing the rule of action in passing upon an application for a patent. These rules Mr. Abel states to be, firstly, that a patent cannot be obtained for a method of operating unless it can be expressed entirely without reference to apparatus or machinery.

No such rule as stated exists. The Patent-laws of the United States recognise four classes of inventions, namely, an art, a machine, a manufacture, and a composition of matter. The class included under the term "Art" is commonly referred to as inventions of method or process, and to illustrate the operation of the United States Patent-office, suppose we take the case of an inventor who invents a certain article of manufacture, also a method or process by which that article may be manufactured, and, thirdly, a machine for carrying out that method or process. The inventor has made three distinct inventions, the article itself, the method or process of making that article, and the machine for carrying ont that process. If in the nature of things it is impossible to produce that particular article except in the exercise of that particular method or process and by the operation of that particular machine or mechanism, and conversely, if that machine in the production of the article does not and cannot produce any other article and does not and cannot carry out any other process or method, then these three inventions are inseparable in their nature and a single patent may issue covering all of them. If, however, the article is one which might be produced by other methods or processes, and if other machines may be devised for carrying out the same method or process, then the inventions are independent and distinct, just as much so as would be two horses having different capacities or capabilities, each adapted to the performance of its work. This being so, it follows that in claiming the method or process it is necessary to distinguish from the function or operation of the machinery employed for carrying out that method or process, for otherwise the patent would cover no more than the mere function or operation of the machine and not a method or process capable of being carried out by many specifically different constructions of machines or mechanical devices. Moreover, every machine in performing its function carries out a definite mode of operation, which is inherent in the mechanism itself. That same operation is performed whenever power is applied to the machine. It is not, however, that operation of the machine which it is the purpose of the patent covering a process to secure to the patentee. If such were the case the patent would be exceedingly limited and restricted and of no value to the patentee, inasmuch as only that particular mechanism would carry out or embody the patented method. Hence it is not only unwise but contrary to the interests of the inventor to attempt to define his method or process by describing the necessary operation of the mechanism employed in carrying out that process. This, however, does not arise from any rule of the United States Patent-office, but from the very nature of the protection which it is desired to secure in a method or process patent, and if Mr. Abel has had any difficulty with the Patent-office in the framing of his method or process claims it has been due to his failure to perceive the nature of the protection which a method or process is to secure to the patentee or to the inventor, because a process or method within the meaning of the United States Patent-laws must be independent of the necessary operation of any special construction of machinery for carrying that process into operation, or else be an inherent principle of the mechanism itself, in which event it is no longer a process or method, but the function of the machine which is inherent in the machine, and which is brought into operation every time the machine is operated, and which is not the inventive idea to be secured in the patent.

The second rule which Mr. Abel alleges has been laid down by the Examiners is that in a claim for a construction of apparatus or machinery you cannot include a description of the manner in which the machinery operates, but the claim must be limited to the "enumeration of the cranks, levers, cams, &c., constituting the machine." In this respect Mr. Abel is equally in error; and if Mr. Abel has been practicing as a patent solicitor upon any such basis and securing patents for apparatus or machinery so limited as would be implied in what he alleges to be the rule in this regard, he has not been securing to inventors the measure of protection which it is the purpose of the Patent-laws of the United States to secure. In claiming a construction of machinery, or in framing claims covering such construction, it is necessary for the solicitor to carry in mind what the invention is, what it is the inventor has conceived, what results the inventor seeks to secure, and in claiming the germ of the idea of the invention it is not necessary to limit or confine the inventor to the "enumeration of the cranks, levers, cams, &c., that constitute" the machine, and to so limit the claim is to sacrifice the very object of the patent, namely, the protection for the germ of the invented idea. In claiming a machine, however, the invention is in means or mechanism for accomplishing the desired object and not in the method of operation inherent in the mechanism itself. The invention is in the arrangement of elements which possess the characteristic of accomplishing the desired end or object and the co-operation of such elements, and not the method of operation which is inherent in such mechanism, and besides it is permissible, and is, as is shown by nearly every patent that is issued from the United States Patent-office, to refer in the claims to the manner in which the elements of the mechanism co-operate and co-act in the production of the desired object and result.

The third rule alleged by Mr. Abel is that a method or process, and the machine or apparatus by which that method or process is carried out, cannot be secured in the same patent. This rule, as stated by Mr. Abel, is correct only in the case where the method or process is capable of being carried out or executed in other specifically different constructions of machines, for in such event the method or process is a distinct idea by itself, and many specifically different constructions of machinery may be devised for carrying out such method or process,

If, however, the method or process can be carried out only by one particular mechanism, and in the performance of its function that particular mechanism can accomplish no other process nor carry out any other method, then the process so-called and the machine are inseparable inventive ideas, and the rules do not prohibit a single patent covering the two.

The fourth rule alleged by Mr. Abel is that separate patents must be taken out for each modified construction. This is a misleading statement of the rule, as a matter of fact. An inventor may make an invention in a machine, for instance. This invention may be embodied in several specifically different modifications or forms of construction, each of which embodies the same generic principle. It is proper and competent to show and describe in an application for a patent all the different forms of machines which embody that same generic principle, and if the generic idea is new, a claim may be secured broad enough to apply to and to cover the generic invention and hence secure in one application a claim broad enough to apply to all of the modified forms. If, however, each modified form has a construction differing from that of all of the other modified forms in sufficient detail as to constitute in effect a different construction specifically considered, and such difference of construction is of sufficient value to be specifically claimed by itself, then a separate patent may be secured covering such specific construction, and so on throughout all of the modified forms, but with a generic or broad claim in the original or parent application broad enough to apply to all of the modified forms, would prevent any competitor from using any one of those modified forms without infringing the patent.

Mr. Abel seems to think that these are wonderful rules, and indeed they are, as Mr. Abel has stated them. They are wonderful to the extent of being unique in the form in which they are stated.

Where a patent issues under laws requiring examination prior to issuance, as to novelty, as in the case of United States and Germany, and carries with it a grant having the presumptions of patentability and of novelty, it is necessary that the grant should clearly define the monopoly granted, and since the claims determine the scope of the monopoly secured by the patentee, under these circumstances it becomes important and necessary for the claims to be clear and explicit in their meaning and scope to the end that the monopoly secured thereby may be readily ascertained so that the inventor will secure that of which he is the inventor, and to which he is entitled, and so that the public may know to what extent it may go without encroaching upon the monopoly granted. From the tone of Mr. Abel's remarks it would appear that he has been unable to so present the claims in his cases as to meet these requirements, and hence he has denominated the painstaking efforts of the Examiners in seeking to secure clearly-defined claims or claims clearly defining the invention secured as the tyrannical actions of self-opinionated individuals. In other words, Mr. Abel is the twelf man of the jury who becomes disgusted because t other eleven do not agree with him.

As to the operation of the United States Paten laws in practice as well as in theory, it seems to l necessary merely to call attention to the fact of t vast advancement that has been made under t American patent system in every line of industry a of the arts. It is only necessary to cite the examp of the Yankee genius and the acknowledge supremacy of the country in the mechanical arts a industries. It is only necessary to refer to the fa that improved apparatus of the most modern type construction are being constantly brought into pra tical operation, whereas in England and her coloni antiquated methods and machinery are still bein employed, whereas England is rapidly losing h prestige and is being crowded out and supplanted b the more progressive elements. This brings us bac to the original proposition, that something should b done to regenerate the British patent system, an that if the present conditions continue to obtain Eng land will be relegated to the rear and left far behin in the race of mechanical achievements.

SAMUEL E. DARBY,

Ten years Examiner in the U.S. Patent-office.

[For previous correspondence on the "Repression of th British Inventor," commenced by Mr. G. A. Lowry, se *ante* pp. 305, 323, 343, 423, 474, 537, 672.]

General Notes.

COTTON GROWN IN THE BRITISH COLONIES.— The following statement, showing the number o bales of cotton imported into the United Kingdom from the British colonies and possessions during the three months ending 30th June, 1904, has been prepared in the Board of Trade :—

British India	98,288 bales.
British West Indies	1,302 ,,
British West Africa	372 ,,
Total	99,962 ,,

VICTORIA AND ALBERT MUSEUM.—There are now exhibited in the Victoria and Albert Museum, some interesting trial-pieces of the late Mr. G. F. Watts, R.A., who painted his first work in true fresco in the Villa Careggi, near Florence, where he stayed for some time with Lord Holland, then the British representative at the Court of the Grand Duke of Tuscany. This picture represents the scene where the physician of Lorenzo Il Magnifico is being thrown down a well, as he was suspected of administering poison to his dying master. These trial-pieces came from the Contessa Cottrell, the widow of a chamberlain of the Grand Duke of Lucca, who was a friend of Mr. Watts, and of whom he painted a fine portrait. They were executed by Mr. Watts in true fresco on a suitable ground, before he began to paint on the wall.

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FRIDAY, JULY 22, 1904.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Proceedings of the Society.

CANTOR LECTURES.

MODERN BOOK-PRINTING.

By Charles T. Jacobi
(Of the Chiswick Press).

Lecture II.—Delivered February 29*th*, 1904.

The lecture last week was devoted to the consideration of various type founts suitable for book printing, and we have now to deal with the employment of those types in order to obtain good results. The question of selection is a most important one, because it has been said by other authorities than myself, and rightly so, I assert, that a well-designed type costs no more than a badly-produced one; and this being so, it must be entirely a matter of judicious selection in choosing an appropriate letter, whether the book is of an ordinary kind or one that may be classed as an *édition de luxe*.

Before proceeding further it will be as well to define the scope of the two lectures I have undertaken. "Modern Book Printing" is the text, and any class of printing outside that title cannot be dealt with in the limited time at my disposal. In fact, we book-printers are always learning something new and profiting by our daily experiences, so it will be apparent to any one that it is not an easy task to handle a somewhat complex subject—the experience of a working life as it is—in a short space of time. All I can do is to touch but the fringe of the heads detailed on the syllabus.

The first item on this syllabus for to-night is that of the choice of type for any particular volume. In selecting a fount we must be largely influenced by the nature of the work—what shape it is to assume, and last, but not least, the price it is to command when issued; because apart from the mere size of the page, the question of the length of the volume has to be considered. As a general rule it is advisable that the largest face of type possible be selected, for all can read a large fount, whereas a smaller one is only legible to a limited number. A large type set solid for the narrower widths of type measure is best, and if the measure across the page is somewhat wide, a little leading is recommended. Besides, the first cost of composing a fount on a larger body is cheaper than that of composing a smaller one even if leaded, although the page may contain the same number of words.

The precise character of face should depend on the class of work for which it is to be employed; for it is obviously clear that a special fount with some artistic pretensions would be out of place for, say, a novel, whereas that kind might be reasonably employed in the printing of a volume coming under the head of *belles lettres*. Again, a purely modern face would not be in keeping with a work of antiquarian research, but a good plain old style or old face character would be more appropriate. One other consideration is that of paper, because an antique or handmade kind would demand a character of type in keeping with it, and nothing looks so inharmonious as a purely modern face, or one of a fanciful design, on such papers.

Again, if more than one size of type must be used in the volume, and this is generally necessary for extract matter or for foot-notes, let the types be of the same character, for the mixture of different faces is not good, and is calculated to offend the eye of any one who appreciates typography from a true standpoint. Be consistent as far as possible in selecting suitable types. The proper selection is but the result of experience and judgment, and is not a difficult matter to acquire; it may be cultivated by most persons.

Something should be said here as to the bodies on which types are cast. Those of the English founders have been, in the past, based on an irregular standard—a rough calculation being that any one type of a certain body should measure so many lines to the foot, pica being supposed to be six lines to an inch or 72 to the foot, but, in reality, this standard was more or less a myth. Further, only some few sizes bore a true relative proportion to each other. Thanks to our cousins—who certainly have scored over us in this respect—the American point system, which is based, without going into

decimals, on the idea that 12 points are equal to one pica, or roughly, 72 points to the inch, is being adopted in this country. The system has already been very largely employed for jobbing founts, and is slowly but surely becoming the standard for book founts. That it is an ideal method of measuring there can be no doubt, because all types on this basis bear a definite mathematical proportion to each other, which certainly did not exist before.

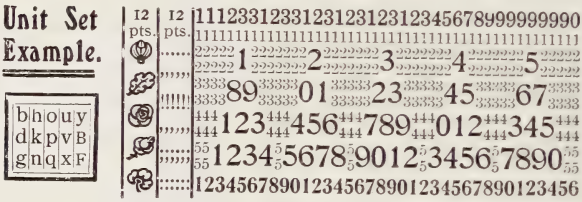
lines, or "leading," as the latter is called, when the lines are opened out, if one is to be somewhat technical. That there should be some ratio between the two ought to strike even the outsider, but it is, nevertheless, a fact that the ordinary printer generally disregards or ignores any connection between the two. I have already said that I prefer as large a face as possible in selecting a fount, and that if the width of the type page is not great it should

Example *of the* Standard *Line* System.

The Splash of a Drop. *By* Prof. WORTHINGTON ...**1/6**
The Birth and Growth of Worlds. *By* Prof. GREEN, M.A., F.R.S. - **1 -**
Aquila non capit muscas........An eagle does not catch flies ***(Latin)***
LONDON, Whitechapel Rd., E. **6** ST. LUKE'S, Old St., E.C. **12**
POPLAR, 9, Barking Rd., S.E. **4** DENTAL, Leicester Square **17**

Some other ideas in connection with the point system are of a later date, and relate to the standard line, and the unit set of the letters. The former method applies to the equal alignment of the different faces on any one size of body, and that too on a definite system of points, or fractions of points, so that the beard, or the space at the foot of the letter, of any one size should bear some proportion in points to that of another body, thus permitting an absolute ranging of all faces on a given body. That of the unit set refers to

be set solid, *i.e.*, without "leads." If this be the means adopted the lateral spacing of words should be somewhat closer than when the matter is leaded or spaced out in depth. To do this consistently in prose matter, especially that set in short lines, division of the words at the end of a line must occasionally be resorted to, but then only with a regard to their etymological derivation. Closely set or non-leaded matter should be spaced between the words just sufficiently to keep each word clear and distinct. Too close spacing is just as objection-



the precise lateral width of the different letters of any given fount—each separate letter being cast to a specified number of units. From these three methods it will be quite possible to standardize all types on such a basis as will allow of a perfect justification of the various sizes one with the other, not only in depth, but in width. But, at the same time, from an artistic point of view, it is just possible that some designers may object to any cast-iron rules being applied that will limit the scope of the different letters of the alphabet.

Having settled the choice of type, something must be said about the technique of composition; by this I mean more particularly the little details of spacing between words and

able as very wide, for the one plan would jumble the words together in a meaningless fashion, and on the other hand, wide or open spacing would be found very distracting and ugly. It is just this latter kind of spacing that will create what Morris used to term "rivers of white" running down a page; in other words, it would present such a chasm as one would see in a brick wall that had a settlement at the "footings," as it is expressed in the building trade.

This closer and regular spacing is naturally more troublesome to the compositor than a "go as you please" style, but if good work is desired it must be insisted on.

Matter that is leaded—but again too much

leading is objectionable—may have the lateral spacing slightly increased. At the same time it must be evenly and consistently done throughout.

Long lines of type set solid, that is without leads, are sometimes objectionable for the reason that it is difficult to take up the running in reading line after line—the eye losing the continuity in leaving one end and taking up the commencement of the next line. One way of dealing with this difficulty is to lead the matter, for the addition of a little more "daylight" between the lines is certainly helpful in threading our way through a printed mass. Still another method would be to arrange the matter in two equal or parallel columns—the shorter lines being so much more comfortable in reading. These points will be found fully demonstrated on the screen.

We have now to consider the *format* of the page, and this is where so many printers fail.

In discussing the shaping of the page, not only the size of the type page as compared with that of paper, but that of the margin must be dealt with at the same time. These two elements, the forming of the page and the placing of it in its proper position on the paper, being correlative. It is perhaps not always the fault of the printer that a book is given a bad shape, because his customer, whether he be author or publisher, insists on having his "pound of flesh" by having too large an area of type for a given size of page. No definite rules can be laid down, but we must recognise as a basis that there are two qualities of books: those of the ordinary class and those of the better order. The latter kind of course requires a somewhat more dainty treatment, and by that I mean a rather more luxurious amount of margin. For instance, the surrounding margin of a small book is somewhat less than that of a larger one, which circumstance in a general way indicates that margins must be increased all round as the size of a book grows.

As I have just said, no absolute or definite rules can be laid down as to the exact proportion of type to that of paper, for it is often a matter of mere whim or caprice, although it may sometimes be determined by an instruction to use a certain size of type with the limit attached to it that it is to make a volume of such and such a length. Having once obtained the precise area of type to that of paper, the exact shape of the page should be subject to more definite rules, because the size of paper would govern the width and length of the type page. When this is obtained the adjustment of the print on the leaf can be settled according to other set rules.

Now, supposing we are not hampered with any restrictions, we take for an example a crown 8vo book of the ordinary class of bookwork, which measures $7\frac{1}{2}$ by 5 in. Here we find that the average area of type to paper is roughly about half, but if it were one of the superior class of volumes previously mentioned the type dimensions should be somewhat less and that of margin a little more.

Taking this ordinary crown 8vo page just mentioned as a basis, the inner back margin should be the smaller, so that the double margin of two facing pages of the open book will exhibit roughly about the same space as the outside or fore-edge of the volume on either side. This would give for the single page say one-third on the inside, and two-thirds on the outside. In order to give effect to this proportion the head would demand a slight increase over that of the back, and that at the tail the greatest margin of all. From this rule it will be observed that the total proportion of the type page in length as compared with that of paper in height should be somewhat less than that of the width, thus giving the larger margin at the top and bottom of the page respectively.

This is where many printers are at fault, in giving too long a type page for the height of paper, and also by placing the print somewhat in the centre of the leaf—this latter circumstance creating the illusion that the page is below the centre of its respective leaf, truly a paradox which teaches us to exercise a truer sense of proportion.

Many theories have been advanced for the larger margins on fore-edge and on tail, and there is probably something in these conjectures when considered. One is that the broader fore-edge gave space for marginal notes or annotations, and that the greater depth at foot of the page gave sufficient room to handle the book whilst reading without obscuring the print. These suppositions are quite reasonable, as is likewise the idea that these wider margins gave scope for illumination or decoration which we observe in the old manuscript books, and which had the same proportion of margins as I have been discussing—in fact, these old manuscript volumes had even a larger proportion of margin than that which I have laid down in the foregoing words.

One other suggestion I have to make is from

a practical and modern point of view, and is that these larger margins do help us very much if a book is to be cut at the edges when bound, and especially so if it has to be rebound at some future time; for it is on those particular edges that most of the wear and tear falls, and if the binder must cut the edges to make the book presentable it would not be so noticeable if the margins have been adjusted on the lines above specified, and provided the binder does not cut too deep, which he is apt to do unless one keeps a tight hand over him.

From a literary point of view I must not omit to remark on the subject of reading and revising of all book-work. A slovenly and carelessly read volume is a great eyesore, and is most damaging to what otherwise may be a good example of work. That the corrector of the press should be a qualified and practical man needs no argument, and will, of course, be admitted. This being granted, all the minor and glaring errors of a literal character will be averted. It is also of the utmost importance to the master-printer that the general reading or revision of a printed book be performed satisfactorily in other respects. To do this efficiently a strict adherence to some systematic set of rules must be observed in order to govern spelling, style, and various other items on consistency—all embraced under the head of "customs of the house." By the adoption of such methods only will uniformity be obtained.

With regard to paper and ink, these are two other subjects which might well be dealt with on separate occasions, for they are both very important factors in a book.

Handmade paper, without question, is the best, but its price and limitation in size of sheet place it outside consideration except for the best class of books of which many copies are not usually printed. The editions generally command a good price, and the difference between a paper made by hand and that of a good quality made on a machine does not affect the total cost very much per single copy, especially when the selling price is a good one and the issue limited. If handmade paper is to be used, that made from linen rags is obviously the best, because that "stuff," as the paper-maker expresses it, is the purer material and the stronger too, whereas cotton is the inferior article and subject to many variations of quality; in fact cotton, I am afraid, sometimes enters very little into some of the fabrics thus designated when placed on the market first hand.

My own preference is for a laid paper rather than for a wove, and this seems to be the general consensus of opinion if printing handmade papers are examined, whereas drawing papers are mostly of the woven kind.

Two important details of paper-making must not be omitted here, and these are that they should be suitably sized (with animal size too) and that they should never be bleached artificially, it being better to have these papers entirely unbleached than to allow any chemical process to enter into the finishing-off stages.

Some few of these remarks apply equally to the paper made by machine, by which method the far greater bulk of paper is now produced, and these include antique papers with deckled edges on two sides, and even those "mould-made" that have the deckles on all four sides. In some cases these mould-made papers are a very good imitation of hand-made paper; in fact, it is difficult, except for an expert, to distinguish some of the better kinds from those made by hand.

Here again the constituent properties of a machine paper should be equally good as in the case of that made by hand, if the best quality is desired. Unfortunately the cheapening of literature has demanded, among other things, cheaper materials, and paper, more perhaps than any other element in a book, has suffered most. In fact, some of the most rubbishy kinds—I cannot say qualities, because they have no claim to such title—are sometimes used for the printing of books. Some of these will crack or split at the corner if a page happens to be doubled over, and others will sometimes leave a thumb-piece behind in the mere act of turning over a leaf. Again, let any one try to open the edges of an uncut book printed on this sort of paper and he or she will observe that it is impossible to cut it with a clean sharp edge. This class of paper, in printing sheet by sheet, frequently leaves a fluffy deposit behind it, so much so that a printing machine becomes covered with this loose fibrous material, which clogs both the rollers and the type, thus resulting in dirty-looking work—to the discredit of the printers.

It is a well-known fact that it is most difficult to obtain a pure rag printing paper made by machine, even if one is willing to pay for the better article. I quite expect the real difficulty, apart from the expense, lies in the

mewhat limited supply of the raw material. ıe other suggestion of my own is that the fferent mills have each their own specialty manufacture, and to make any exception their standard formula would be considered o much trouble for the sake of occasional nall or special orders.

I have already said at previous lectures at calendered or coated papers should not employed unless the printer is compelled the exigences of illustrations by the pro- ss methods. I have sometimes met people ho estimate a good paper by its shininess its insidious and clammy touch in hand- ng—and I have sometimes, though unhappily ot always, succeeded in correcting such ews on the subject. Rolled papers are metimes necessary evils, but there should e no occasion to adopt a paper with an rtificial finish to it, unless it is an absolute ecessity for the better production of a work ıat has process blocks of a very fine line, or ıose by the half-tone method.

With reference to ink, this too is an impor- ant factor, and the necessary medium in ansferring type to paper. As in other things, he best quality is the cheapest in the long run r many reasons. One, from a workshop point f view, is that a higher grade of ink goes ırther than an indifferent one, and secondly, good quality of black is permanent, and will lways be satisfactory. The cheaper inks are ısually made from vegetable black, or produced rom the carbon of gas, and are not really quite lack in the dense body, for whilst fresh from he press they may have a suspicion of that 'colour,'' they will perhaps degenerate into a aded one, possibly of a gray or a brownish ue.

Nothing could be more simple than the in- gredients of a really good black ink, but it is ssential that these ingredients be pure. For nstance, varnish made of the best boiled inseed oil with the colouring matter of lamp- lack added should be the two most important constituents of a good ink. That lamp-black which is the product of burning oils by slow combustion is the purest kind for the purpose, and may be considered permanent as regards its blackness and lasting quality, provided it is not tampered with in order to expedite its drying properties. To some extent the varnish may be treated first-hand so as to render the pigment faster in its setting action without prejudice to its colour or permanency, but this is not so necessary if the ink is to be used for papers wetted down prior to working, although it may be requisite for those which are to be employed on dry papers, especially those with a smooth, rolled, or coated surface.

Fast running machines demand a quick drying pigment, and in yielding to this demand it is the inordinate doctoring of the medium that is largely responsible for the deterioration of printing inks in a general way. Again, process blocks, particularly of the half-tone method, have necessitated some chemical being introduced into their manufac- ture in order to impart life or brightness to the picture, but this often gives a metallic effect not desirable.

This ink, if used for dry papers of the rolled or coated kinds may be innocent enough in its action, but woe betide any printer using it on one that has been wetted-down for print- ing purposes—it still being necessary to work papers in that condition if they happen to be handmade or of the rough antique kind.

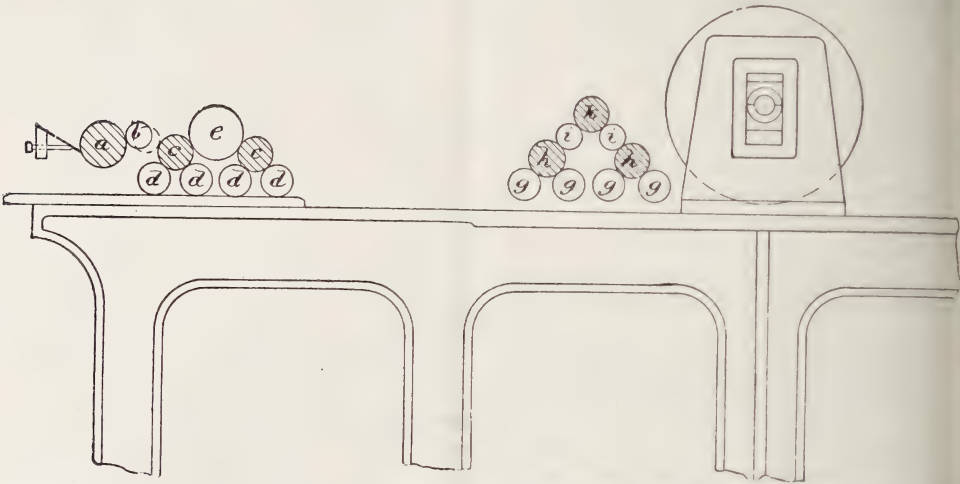
We have now reached the subject of actual press-work, and this embraces all work under the head of printing, whether it be produced by hand or machine. As a matter of fact, very little hand-press work is done anywhere except by the private presses, and for their purpose the old hand-press answers all the demands made on it. For general printing, power-presses of much larger capacity and more rapid output are demanded, in order to keep pace with the times and to cheapen the cost of production. This is the natural result of competition.

Although the Chiswick Press still does some portion of its work by hand, it is no secret that many of the most sumptuous books turned out by that Press in recent years, under my superintendence, have been produced by machine — mostly of the single cylinder or Wharfedale kind. This some years back would have been considered an impossibility, but the present-day standard of efficiency, if I may venture to term it so, has only been reached by a long and tedious training, and as our own machine men are all put to the hand-press for the first few years of their apprenticeship, it gives them an intelligent appreciation of the work that lies before them, and the product is a joint one of brain and machine. This is an end to be desired; for otherwise, if a man has been taught his craft at a machine only, he has, as a rule, no eyes or ears except for the mere mechanical perform- ance of the respective functions of the power- press under his control.

For the careful printing of book-work the single "stop" cylinder machine of the

Wharfedale class, providing it has all the up-to-date accessories, is admirably adapted. Of this particular class of machine there are several good kinds of English manufacture, and I do not recommend any one more than another, excepting that I strongly advise the adoption of those only of reputable firms. By accessories, I mean all the details that add to the efficient making of the machine. For instance, any press chosen should have a thoroughly good ink distributing arrangement, and full rolling power which can be regulated according to the class of work proposed to be printed. These points can only be obtained by the ample provision for a sufficiency of rollers, both for thoroughly distributing the ink, and for applying that ink, in a proper manner, of the precise quantity. Beyond the number of rollers it is necessary to have a reciprocating metal drum or other arrangement for the greater distribution of the ink before it reaches the distributing table. In applying the ink, which is regulated in its supply from the fountain or ductor by means of keys, it is also needful to avail ourselves of the geared apparatus attached to the rollers which convey the ink to the type after its proper distribution —these rollers being defined as "inkers" as distinct from those termed "distributors." These features now recommended I will explain more precisely from the diagrams on t screen.

It will be seen from this particular diagra that the ink is conveyed to A by the kn situated at the extreme left, the supply which is regulated by a series of keys. is then lifted by the vibrating roller B to and so on till it is thoroughly well and eve thinned out when it is placed on the slab u derneath and further distributed by the seve rollers marked D. As the forme carriage trav to and fro the inkers G take the requisite amou of ink as the slab passes under, which in tu is further triturated by the geared metal a composition rollers piled on top before it applied to the printing surface which al travels underneath—the inking slab and th printing matter being situated at the two e treme ends of the carriage which runs on ra under the cylinder.



Geared Distributors and Inkers, nested in Pyramidical order. Shaded = metal, an Open = composition rollers.

Distributors.
a. Metal Ink Roller.
b. Composition Vibrating Roller.
c. Metal Riders.
d. Composition Distributors.
e. Composition Rider.

Inkers.
g. Composition Inkers.
h. Metal Riders.
i. Composition Riders.
k. Metal Rider.

To obtain depth of "colour" in printin it is not so much a question of quantity a of actual or sufficient rolling, for an excess o ink, given out indiscriminately, chokes up th printing surface and results in bad work, quit apart from the waste of the pigment. No unlike a certain table condiment, it is fre quently not that which is actually used, bu that which is wasted, where the expense fo ink largely comes in.

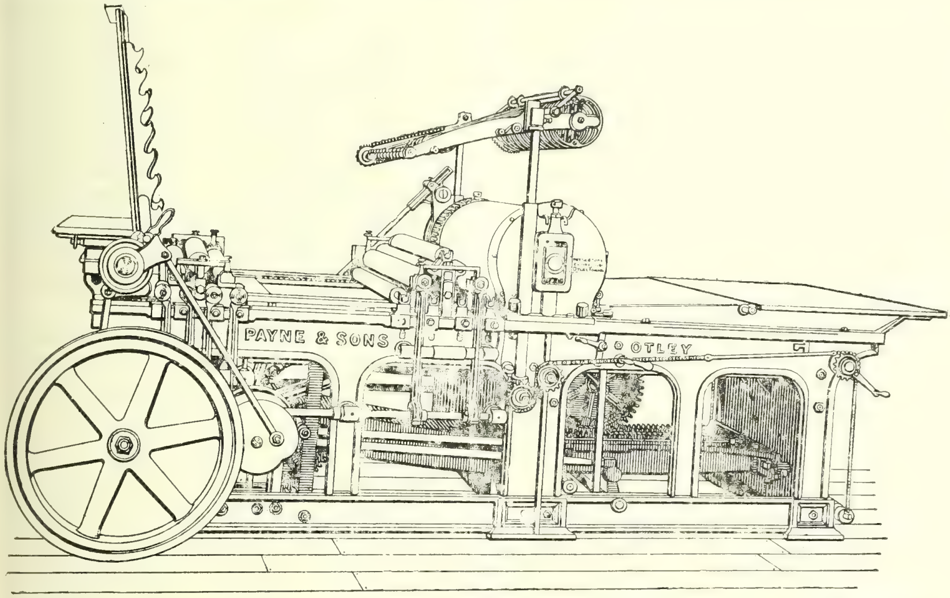
Of course the actual construction of th

machine is of the utmost importance, and great care should be exercised in selecting one to see that the different parts have the necessary strength without being cumbersome, because all sorts and conditions of work have to be produced from it. The floor in the first place should be solid in order to resist vibration; and the frame of the machine itself should be rigid. It is also important that the carriage or table on which the printing surfaces travel should be well supported by a sufficient number of strong traverse rails according to the size of the machine, so that when the actual impact of paper with type occurs, that is, as the cylinder revolves over the type which travels underneath, there may be no spring in the impression, otherwise there would be a want of soundness in the work, which would very likely create a slur or blemish on the sheets as printed.

To enter more fully into the construction of a printing machine does not come within the scope of my lecture to-night, for it is a subject that would require quite a separate and distinct treatment from a mechanical engineer. All I can do is to enumerate some of the principal points to be sought for in the selection of a suitable machine.

There are many other classes of printing machines—some of the double cylinder kind called "perfecters," that print by two impressions both sides of the sheet before it leaves the machine, thus delivering perfect sheets, but all those of that character have, more or less, difficulties in dealing with the set-off of ink from the first to the second side in the reversal of the sheet in printing, and therefore these machines are not advisable for the best class of book-work.

Others there are of English make and of the Wharfedale kind termed two-feeders. This particular class of machine has a longer travel for the type forme, and has a duplex arrangement for inking and rolling at both ends of the machine. Unlike the "stop" cylinder or a single feed machine, which is stationary on the return travel, the impression cylinder of the two-feeder immediately reverses on the completion of each revolution, on the same principle as the old so called "tumbler," and in doing this the sheet is seized by the grippers, of which there are two different sets. Shortly, the general principle is, that two sheets are printed, that is one each way as the machine travels to and fro—whereas, on the one-feed "stop" cylinder machine, only one sheet is produced at each double run, the cylinder in this instance being locked or thrown out of gear, as it were, on its return journey by means of a push-rod worked off an eccentric cam.



Stop-Cylinder Wharfedale Printing Machine, with Geared Distributors and Inkers.

The two-feeder machine is generally used for the printing of illustrated magazines where a large out-put is requisite.

Those machines of a rotary kind that print simultaneously both sides from a long reel of paper, are adapted for newspaper or magazine work of long numbers only, and do not apply to book-printing. I may here mention that these machines are becoming more adapted for the printing of illustrations, so that there will be by and by practically no limit to the class of work for which they can be used.

There are several types of American machines at work here in London admirably suited for the better class of illustrated magazines, of which the Miehle, the Cottrell, and the Century, are good examples. Very ample inking and rolling power arranged in pyramidical fashion is to be obtained from these machines. These machines are of the two-revolution kind, as distinct from those on the stop cylinder principle. Each actual impression given by these machines require the cylinder to rotate twice and always in the same direction.

As the cylinder and working parts of these American machines are adjusted to such a nicety they effect a great saving of time in "making ready," and turn out very satisfactory work indeed. They are also geared to run at a faster rate than the English machine of a similar class—a consideration for magazine work of a long run, but which does not affect book-work so much because the printing numbers of that class of work are usually smaller.

Given a good firm machine, with all the accessories needful for the proper working of its more automatic functions, by which I mean the proper distribution and application of the ink, the next important step is the preparation or making ready of the type, blocks or plates, as the case may be, for printing. To arrive at this in a satisfactory and expeditious manner will prove the workman, for some almost labour in vain, and do not attain the results which a more competent man will arrive at in half the time.

The cylinders of machines now-a-days are usually so truly planed and adjusted to such a small intervening space between the impression cylinder and that of the printing surface that a good deal has first to be done by an even and consistent underlaying, supposing it is a forme of mixed blocks and type or plates. This having been arrived at in a satisfactory manner is half the battle, and the overlaying requisite for the complete making ready should be all plain sailing and not very difficult to a competent hand. In theory new type printed on a new machine should require little or "making ready" in order to make a sta but in practice it is not so, for no type machine has ever been made and adjusted such a mathematical nicety as to require preparation before starting printing.

This necessary making-ready or preparati for printing requires in a workman a go perception of light and shade, and an inte gent appreciation of the difference between light and heavy impression in examining a preliminary pulls from the machine during t course of preparation.

It is quite possible to obtain a single a fairly good flat proof—just from the rough u prepared forme of type, but if we wish uniformity of both inking and impression printing of the various sections that go to t making up of any one book, it is absolute necessary to put the printing matter into su a condition that this uniformity will be o tained. This having been done properly at t outset, it should place the various impressio of the different sections of a volume all on equality, no matter the length of run, provid the workman keeps his eyes on the progress the work.

Absolute cleanliness is most necessary f the proper production of good work, and if t working printer is lacking in this virtue, it is hopeless task to attempt to teach him how produce really first-class work.

Some attention must now be given to t setting out or display of title pages, and this very requisite in most printing offices. I mus however, admit that there is a general in provement in this respect. I need only ref any one to the window of any well-know bookseller where new books are displayed- usually with the title pages in full vie The point to be aimed at in setting out title is that it should be consistent from t to bottom; that is, that one kind or class type only should be employed as far as po sible, although there may be some very fe exceptions to this rule, such as somethin very special or parenthetical which wou require some other type in order to secu some differentiation from the bulk of t page; one other exception would be, say t title page of a work of an ecclesiastic nature. Here a line of Gothic for the ma title would be quite permissible, I thin Another point is that as few sizes of ty should be used as possible — the effect of title page set in all one kind of type and a few sizes only is far more pleasing than

variety of characters and sizes be adopted, r a title arranged in this latter style would rate or jar on one's nerves.

Formerly it was customary to crowd into ny one title page, or piece of displayed atter, just as many different types as ossible, but I am glad to say that a etter style and purer taste now pervade the rinting trade, and these in turn are being ppreciated by the general reading public. his may be confirmed by the reference I have uggested to the new books in many bookellers' windows.

As a conclusion, I wish to emphasise, among ther things, the necessity for co-operation ith the binder for the better production of ooks; in fact, this spirit should prevail among ll those who take some part in the manuacture of books, commencing with the typeounder and then the stationer and the inknaker.

Some of the points that will help the binder re those arising out of the selection of a uitable paper, and as the printer does not lways have a voice in this matter, it should e the concern of those who supply that comnodity. A bad paper may take print fairly vell at the time of its impression, but that robably is all that can be said, for it will ot stand fair wear or usage. One other ritical test for this article is, will it take eedle and thread satisfactorily? That some inds will not I can vouch for. This circumstance in itself condemns it from a binder's oint of view.

It is essential, too, when the precise substance of the paper to be used has been deternined on, that the different sections of any work to be printed should be neither too thick nor too thin. Judgment must be exercised by the printer in deciding the number of pages or leaves that should constitute the signature which forms the sheet when folded up. When printed on thick paper, and in too large a section, a volume will not open readily or lie flat, but will be inflexible or clumsy, and reflect no credit on the binder.

One thing that is a question for the bookbinder himself is the method of machine sewing. That this process is necessary in these days of cheap production will go without saying, but at the same time that is no reason why any method which has the effect of damaging a book should be employed. I refer to that particular method of sewing which involves the slitting of the top and bottom of each section. There may be a small advantage in the possible avoidance of a crease at the junction of the different folds in an uncut book, which is the excuse sometimes, but this crease is not an insuperable difficulty, and should not be tolerated in a book that has any pretensions to being a fine one

A volume with its edges too much cut round is frequently a great eyesore, and only discovered when a book is bound and delivered. The excessive cutting sometimes necessary can often be prevented in the first place by a system of proper margins on the part of the printer. Supposing there is not much variation in the size of the sheets of paper, there should be no great difficulty in arranging equal margins on the fore edge, no matter how large the sheets, or if printed as a 32mo or even 64mo, provided an average size of sheet is selected at the start and the margins adjusted to that particular one. Everything else throughout the volume is a question of careful gauging when once the precise measurements have been determined, and careful "lay" in printing off. By these means, the "bolts" of the folded sheets would stand out properly, and the binder would not have to cut so deep in opening the edges of the book.

On the other hand, the binder does not always exercise that amount of foresight he ought to in looking ahead, but sets his gauge too small and the result is disaster, for the margins have been hopelessly ruined. A piece more can always be cut off, but it is impossible to restore that which is sometimes ruthlessly sacrificed by sheer carelessness or want of forethought on the part of the binder.

Again, nothing is so bad as to observe the headings of the pages all up and down in a sewn book. This may be due to various causes, and both printer and binder should be on their guard against this defect. It may be that the different pages on a printed sheet have not been gauged up properly, or not straight-edged as they should be, or it may be bad registers in backing up the second side of the sheet whilst on the press. If not the result of either of these faults, it would be due to careless or bad folding on the part of the binder.

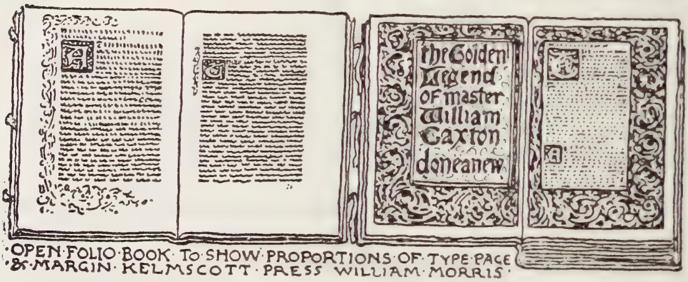
Shortly, as a summary to this lecture, good book-work is the result of judicious selection or judgment, combined with the requisite experience to apply the necessary materials in order to produce fine work. Without these conditions ordinary or indifferent printing will still prevail.

The aim should be to secure a good effect from the two open pages of any volume, but at the same time its legibility must be considered and not sacrificed in attaining that end.

I cannot do more than recommend an earnest study of the best books, and though it is impossible to reconcile all ideas on the subject of what are considered the canons of good taste, very much improvement will be effected in the general run of work produced from the printing press, provided the workman will take an intelligent interest in his craft. Apart from competition, and I wish it were always that of a stimulating or emulating nature and not of a cutting kind, the printer has many advantages in his favour by having improved appliances to hand, and, as I pointed out in my previous lecture, work is done under much better conditions than formerly, those of light, air, and ventilation being primary essentials in the production of really good work.

The improvement in rape-seed is chiefly due to the bumper crop in the Punjab, which has been exceeded only in the phenomenal year 1900-01. Assam has good average crop of mustard, and Bengal, which has estimated for a 90 per cent. crop on an area 3 per cent. larger than last year, though somewhat below the average, accounts for 58 per cent. of the total production. The estimates for this province are, however, decidedly conjectural. Sind, owing to favourable inundation, has a remarkably good crop, nearly three times as great as last year and double the average.

In Bombay the total area sown with linseed in the British districts and Native States comes to 294,000 acres (193,700 in the Deccan) being 48 per cent. over last year's area and 3 per cent. above the decennial average. The yield is estimated to be 25,600 tons, nearly double of last year's yield, and 13 per cent. over the decennial average. The increase in area is general in the Deccan and Karnatak, and is due to larger sowings of wheat and jawar with which the oil-seed is sown mixed. The crop has been fairly good everywhere, though excessive late rains



Reproduced from a Drawing by Walter Crane.

Miscellaneous.

INDIAN OIL-SEED CROP.

The following particulars on the oil-seed crop of British India in 1903-4, are taken from a memorandum issued by the Statistical Department of the Government of India:—

The predictions of the second forecast issued on the 10th March regarding the large acreage and generally favourable conditions of the crop of winter oil-seeds have been fully confirmed. For all oil-seeds the increase compared with 1902-3, which was on the whole a favourable year, is 18.5 per cent. in acreage, and 22·5 per cent. in yield. The area under linseed in the United Provinces is unusually large, but owing to excess of moisture the crop was sown late and is expected to yield only 80 per cent. of the normal. Bengal has a good average crop somewhat better than last year, and the Central Provinces with a rapidly expanding area has a crop nearly 82 per cent. better than 1902-03. The increase in Hyderabad is only apparent as it is caused by including jagirs which did not appear in previous years, but in Bombay the yield is nearly double that of last year.

induced disease and rust in the Bijapur district in the Karnatak. The area under rape-seed is returned at 153,600 acres (35,900 in Gujarat and 117,700 acres in Sind), which is 15 and 10 per cent. respectively over the last year's area and the decennial average. The yield is estimated to be 28,500 tons (5,800 in Gujarat and 22,700 in Sind), 82 per cent. in excess of last year's crop and 30 per cent. over the decennial average. In Gujarat there was a decrease in area as well as in yield owing to deficient late rains. In Sind the inundation was favourable and the outturn good, amounting to nearly double of the decennial average.

In the Nizam's territory the area under both linseed and mustard was much larger than in the preceding year. As regards yield, linseed shows an increase over the preceding year's outturn, but in the case of mustard, of which little is grown, there is a decline. Comparison with the quinquennial and decennial averages is misleading, as out of the jagir areas of 157,000 acres under linseed added this year, only 20,500 acres were included in 1902-3, and none in previous years. Owing to excessive rain, autumn sowings suffered considerably, and winter sowings had to be suspended. Severe cold and insects also injured the crops in places.

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ll communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

TEN - VOLUME INDEX TO "JOURNAL."

The new Index to the *Journal* of the Society of Arts for volumes xli. to l. (1892-1902), is now ready, and can be obtained by members on application to the Secretary, John-street, Adelphi.

The price of the Index to non-members is half-a-crown.

CANADIAN FORESTS AND FORESTRY.

By A. Harold Unwin.

Before dealing with the subject of Forestry, a word must be said about the political divisions of Canada, as these very largely determine the different treatment of the forest areas.

There are different provinces as well as the Dominion itself which own the lands. Prince Edward Island, the smallest in the East, then Nova Scotia, New Brunswick, Quebec, Ontario, Manitoba, North-West Territory, British Columbia, Yukon Territory; then the unorganised territories which are all under the management of the Dominion.

Each and all are more or less interested in lumbering, and have taken different means of developing that industry. Each will be considered in turn, showing the progress made.

In a paper last January on the Canadian North-West, by Mr. Hickman,* a very good idea of the geographical features of the great granary was given, so that here nothing need be said on that. We can at once consider the forests themselves, which occupy according to Mellard's calculation, 38 per cent. of all the land, including the barren lands in the north as well as rivers and small lakes, so that really the percentage is still greater, no doubt nearly 50 per cent. in all.

* Proceedings Royal Colonial Institute, vol. 34, p. 76.

The great forest belt has many well-known runs, from Labrador in a north-west direction right across the continent to the mouth of the Mackenzie river, considered to be 4,000 miles in length and 700 miles in width on the average. Besides this there are large areas in Nova Scotia still wooded, as also in Old Ontario, and much more in New Brunswick. Last and not least there are the enormous areas of forest in British Columbia and Western Alberta.

The above gives shortly a sketch of the outline of the forests, which contain in the aggregate 134 species (according to Dr. Bell). Of these the white pine or Weymouth pine (*pinus strobus*), White spruce (*picea alba*) of the Eastern provinces, and the red fir or Douglas fir (*pseudotsuga Douglasii*) of the West are the most important.

Weymouth Pine, known on the market as Canadian White Pine, is of universal utility, and being found in large quantities is easily worked and commands the highest price. Growing from Nova Scotia to the eastern boundary of Manitoba, the areas yet untouched are enormous. It is being surpassed in the quantity used perhaps by the white spruce, which, quite apart from its use as plank, &c., is of course the chief pulp wood, and also black spruce (*picea nigra*). It is difficult to compute the areas of spruce, as it extends roughly from the eastern coast to the mouth of the Mackenzie, and even finds a counterpart in the forests of British Columbia in the shape of the Western or Sitka spruce (*picea sitkaensis*) and Engelmann spruce (*picea Engelmannii*). The wood is identical with the European spruce, so that a further description of it is unnecessary.

The Douglas fir (*pseudotsuga Douglasii*) the monarch of the real conifers (narrow sense) is the most widely distributed tree and most manufactured into timber of various kinds there. As much as 44,300 cubic feet per acre have been cut, and a section 11 feet in diameter is being sent to the St. Louis Exhibition. This tree has shown remarkable powers of reproduction under the present system of fire protection in the railway belt of British Columbia. It is destined by its rapid growth, and remarkably sound and durable wood to

become one of the most important commercial coniferous timbers of the world.

Next in importance are perhaps the cedars or arborvitæ; *Thuia gigantea* in the West and *Thuia occidentalis* in the East. The former the great protector from rain in the shape of shingles, which even find their way right across the prairies to the East, where they compete quite favourably with those of the sister tree. The latter the great supporter of thousands of miles of telegraph wires and steel rails. It has also found a place on the Western farm to support barbed wire. Remarkably light in weight, and durable when exposed to the atmosphere, the abundance of the material, has gone a long way to give them such an important place in the economic timber of Canada.

The Red Pine (*Pinus resinosa*), not occupying the position of its counterpart in Europe, comes perhaps next. It is scarcely ever found on enormous areas such as in Europe, and it is not so large as there. It is confined to the East, but has a near relation in the West in the Bull pine (*Pinus ponderosa*), and also others, such as *Pinus Bankseana* and *Murrayana*, both of minor importance.

Of the Hardwoods none are exceptionally important, at least not all comparing to the conifers, except perhaps the hard maple and yellow birch (*Acer saccharinum* and *Betula lutea* and *lenta*) also white birch (*Betula papyrifera*). These, the former yielding birdeye maple and the latter false mahogany, are chiefly exported. The walnut and butternut (*Juglans nigra* and *cinerea*), especially the former, has a great value; but though its timber is almost priceless, its limited area of distribution makes it commercially less important. The same may be said of the ash (*Fraxinus Americana*), basswood or lime (*Lilia Americana*), elm (*Ulmus Americana*), oak (*Quercus alba*), though latterly a good deal of this has been exported; also of hickory (*Larya alba*). The aspen poplar must not be forgotten, as it plays an important part in fuel supply of the farms in the West, and is worth $12 to $16 per cord. The hemlock (*Tsuga Canadensis* of the East, and *Tsuga Mertensiana* of the West), has not attained great value, but is gradually coming into favour, especially as better timber rises higher in value.

Taken collectively, the broad-leaved trees, both hardwood and softwood, are very important to Canada, especially locally, in home consumption, but they never will be of great importance for export; the conifers being bot[h] for home use and export, the paramount timbe[r] trees. It is difficult to get the exact figur[es] but, roughly speaking, only 10 per cent. o[r] 15 per cent. of the timber exported is fro[m] broad-leaved trees; the rest, from 85 per cent to 90 per cent. is from conifers.

In this respect, Canada has a unique position. The hardwood area, to the largest extent in south-western Ontario, and to a lesse[r] degree in the eastern provinces, is comparatively confined in outline. In contrast the conifers spread mixed from coast to coast over enormous areas. From this, th[e] future sylvicultural policy is almost laid down The broad-leaved trees, such as walnut, oak ash, hard maple, hickory, and yellow birch will receive most attention; and of the conifers, the white pine, black and white spruce, also red spruce (*picea rubra*), also arborvitæ, and red pine or Norway pine in the East. In the West, the broad-leaved trees come in for a good share of attention in the prairie, but do not deserve much notice or care on the Pacific Coast, with its Douglas firs, hemlock, cedar, and larch, which contribute its chief timber-producing trees.

The area for which merchantable timber is growing is 200,000,000 acres, according to an estimate of the present Superintendent of Forestry, Mr. E. Stewart, D.L.S. This is no doubt a very conservative estimate; and also, according to a calculation made by the same authority, would yield at 200 feet, broad measure, per acre—no doubt too low an estimate—53,200,000,000 feet B.M. per year, that is 4,450,000,000 cubic feet. He also estimates the present standing crop at 44,500,000,000 cubic feet, also no doubt too low, but nevertheless giving an idea of the immensity of the forest wealth with which Canada has to deal. Few have realised its size, and few realise its bearing on the timber supplies of the world. It is to develop and wisely use this, that a few years ago the Canadian Forestry Association was formed, also by Mr. E. Stewart, in order to stimulate interest in forestry as well as other organisations. It has a membership of upwards of 500 from all parts of the country after four years successful work, which shows that in time it will become a powerful influence for the good management of the forests. This is the only organisation and quite unofficial which embraces the whole country in its scope of work. Gradually but surely the public, through the press, is learning to appreciate the forests and

heir wise management, as is seen by the ncreasing attention paid to it and to the articles bearing on that subject.

Returning to the conditions in each province. To begin with, Prince Edward Island still has about 15,000 acres of Government and largely suitable for forest in the centre of he island, but at present nothing has been done to promote a rational utilisation of the few remnants of the forest there. At present a Commission is sitting to report on the situation and suggest measures for the future.

Nova Scotia, which next calls our attention, is not quite so badly situated; the Government still holds 750,000 acres mostly covered with forest, and until recently (1899) all timber lands were sold outright to the limit holders instead of leased as is done in other provinces. Hence the small quantity left.

Much the same applies to New Brunswick, except that there are areas of virgin forest still left, and also these are larger in extent. At present there are no forest reserves, but some are to be made, as a law was passed providing for the establishment of a forest reserve or permanent forest areas, but at present this has not become operative. A license for the right to cut timber on Government lands is issued, and besides paying a royalty of $1·50 per 1,000 feet B.M. or ¾d. per cubic foot and a ground-rent per square mile, the licensee pays a bonus which is decided by public competition.

Recently meetings have been held in Fredericton, the capital, as also in Halifax, with great success by the officers of the Canadian Forestry Association to awaken interest in forestry.

In Quebec, the second largest province of the Dominion, a definite forest reserve has been made; the Lawrentides National Park, with an acreage of 2,531 square miles. Besides this, recently a Commission in Forestry suggested another large area to be permanently set aside. Another reserve—Trembling Mountain Park—was allowed for, but the law has never become operative.

Similar regulations as to the granting of licenses and royalties prevail. A Department of Forestry and Fisheries exists, and does what forest fire protection it can with the limited staff and appropriation at its disposal on the enormous areas under its control.

Quite recently the University of Laval, Quebec, as also McGill, Montreal, suggested inaugurating a course of Forestry, a suggestion which will no doubt be carried out in a few years.

Ontario, the next province westward, has entered upon a forward forest policy. Land unsuited for agriculture is to be set aside permanently for timber production, and already reserves situated in various parts of that large province in the aggregate amounting to 10,000 square miles have been set aside. Besides this, a very comprehensible fire ranging system is in operation during the dangerous months whereby all timber limits are protected, and also the other forest land. This is being extended from year to year. Each limit holder (licensee) pays half the cost; the Government the other half. The lumbermen also pay a royalty of $2·00 per 1,000 feet B.M., or 1d. per cubic foot, also a ground-rent of $5.00 per square mile as well as the bonus.

Prior to 1892 it was ½d. a cubic foot, and from 1892 to 1903, ¾d. a cubic foot, clearly showing the rapid increase caused entirely by the increasing value of the timber.

The revenue from the forests represents one fourth of the total from all sources; 1¼ millions of dollars out of nearly 5 millions. Just recently a sale of timber limits was held aggregating 826 square miles, which realised $3,667,000, or £890 per square mile; the previous record being £731 per square mile. The highest price paid per mile was £6,200, and the previous record was £3,400. These prices clearly show the very rapid appreciation in the value of pine especially. The monetary yield of the forest, then, is made up of three parts: the bonus paid for the right to cut the timber on limits until exhausted, granted yearly for 15 years; the royalty per 1,000 feet B.M., and the ground-rent per mile.

As in Quebec, also in this province to even a greater extent, the timber industry is the largest and wealthiest, from cutting waney timber in 32 inches square and 48 feet long to making charcoal for smelting, as at Deseronto every factory using wood is represented.

In order to promote and strengthen the home industry the export of logs in the rough from Crown lands is prohibited, as also pulpwood. This as time goes on will have an appreciable influence in forestry, by the localising of the milling plants.

Forestry Education.—The Senate of the University of Toronto has decided to inaugurate a three years' course in forestry, but at present the Government has not voted the necessary means to carry out the project. At Queen's University in Kingston, in a course extending over four years is to be started in conjunction with the School of Mining. A

course of lectures was given there last year by Dr. B. E. Fernow, late of the Cornell Forestry School.

Manitoba and North-West Territory.—The lands in this part of the Dominion are largely controlled by the Dominion. Two Fire Laws have been enacted which are ably enforced by the North-West Mounted Police, as also by the railways and forest rangers, and in that way serious prairie and forest fires are prevented.

British Columbia.—Here also a Fire Law exists, and is more or less enforced, but at any rate yields better results in protecting timber than across the line, where only a year ago millions of dollars worth of timber, as also mills, were destroyed by most disastrous forest fires.

The Dominion.—Some four years ago a new branch known as the Forestry Branch of the Department of the Interior was started with a Superintendent of Forestry and Timber as head of it. Its work up to the present has been chiefly protecting forests in the West, *i.e.*, on Dominion land, as also in the railway belt of British Columbia. This is a strip of land largely forest 20 miles each side of the Canadian Pacific Railway through British Columbia, roughly 500 miles long or 12,880,000 acres, mostly forest. Here rangers have practically prevented fires during the last few years. The men in Manitoba and the North-West Mounted Police have been almost as successful in keeping fires out of the forest reserves aggregating 8,375,000 acres (in British Columbia 626,000 acres); but these are enormous areas for about 30 men and inadequate means placed at the department's disposal.

The other, and perhaps just as important half of the forestry branch's work, has been the encouraging of tree planting on the prairies of the West. Here from a modest beginning in 1901 when 18 settlers were supplied with 63,000 trees free, this year 1,050 will receive in the aggregate 1,500,000 trees. The trees are supplied wholly without charge and of the following species: Manitoba or ash-leaved maple (*Acer negundo*), Dakota cottonwood, Western aspen poplar (*Populus deltoides*), green ash (*Fraxinus viridis*), and white elm (*Ulmus Americana*).

A large nursery and experimental station of 120 acres has been started in the West. In the near future examinations of the reserves are to be made and schemes of management drawn up.

Similar license regulations prevail on Dominion land such as are in vogue in Ontari and Quebec, with some slight modifications A large revenue is obtained from bonuses a also from dues and royalties on timbers cut.

In summing-up the above, the first questio that naturally arises will be—Are the forest being overworked? The answer is—no in th aggregate, and they cannot be for years, bu locally, yes, for they have been in the past Herein, too, lies a very salient feature of th exploration of present virgin forest whicl needs a remedy.

A timber limit holder has the right to cut al timber in his berth, and when he has cut all he has to give the berth back to the Govern ment. He holds it as long as there is mer chantable timber on it. He has it for perhaps 15 years. If he is cutting on what would be i cleared good agricultural land, he canno clear it too fast as there are always hundreds of settlers ready for new land. If, on th other hand, he is cutting on rocky anc stony land there is no permanency in his operation as when he has finished, the forest must gradually reseed itself. He goes to another part; the mill he has erected is perhaps left to go to ruins. Hence there is nc guarantee of a definite permanent supply from that piece of forest, which must remain as forest. This varies with the different holders, as some have cut on their limits for 40 years and can still cut another 30 years, which means that they have nearly cut the amount grown each year on the total area of the limits (sometimes 800 or 900 square miles). Already some have to bring their logs 100 miles by rail to the mill and others many miles by water. Perhaps one-hundredth part of the total forest areas have been taken up. Hence the reserves have become a necessity. From them constant supplies will be taken, and they will not become depleted as they will be put under definite management and approximately equal annual cut made being sold at so much per 1,000 feet. In the past the forest has been considered more in the light of a mine from which something could be taken once and then not again, or perhaps in the dim future. With the idea of getting a constant and increasing supply of timber from the forest, a new era has begun, and with the reserves in the aggregate some 25,000 square miles, or 16,000,000 acres, this will be assured.

This area makes nearly one-sixteenth of the estimated area containing merchantable lumber, and is being constantly increased. These are being made on a large scale as Dr.

chenck, a well-known German Forester (Biltmore, North Carolina), said in his report on the Canadian Forests, that reserves should not be under 100,000 acres. Indeed the forest problem, with its enormous areas, is so vast that it really seems true, also of Canada, as President Roosevelt, of the United States, recently said, "the water and forecast problems were the most important internal questions of the United States."

Even carried out on a gigantic scale adequate forest preservation by wise utilisation will take a long time to accomplish, especially as the older system must gradually merge into the new, thus instead of living on one's capital, we shall only use the interest. That public men know this to be the case I may be permitted to quote from Byron E. Walker, of the Canadian Bank of Commerce, who said, when speaking of a recent timber limit sale: "The Government has no right to consider the proceeds of that sale as revenue. The conversion of fixed capital into cash does not constitute revenue, but is a distinct loss to the country by cutting off the source of revenue."

In that connection it will be seen that the people must gradually realise this as well as the lumbermen, and then a regular forest policy can be established.

Even the planting of trees in the West has revealed much, and education to the people there who know how to appreciate the trees and their real value to the community will do more. Even if not many acres are planted still a great many persons learn what forestry is and what the forest means to the country, and that is very important and cannot fail to have its effect in due course.

Another question must be asked—Are the forests properly protected from fire? Simultaneously with the setting aside of forest reserves, a system of fire ranging, as we have seen, has been adopted, and is being rapidly extended to forest areas which are not being worked at all. The loss from fire is gradually but surely decreasing. Only a year and a-half ago millions of dollars worth of timber were destroyed in Washington and Oregon, in the United States, whereas just over the boundary, in British Columbia, not a stick was burnt. Nevertheless more protection is needed, and we should not rest until all areas of merchantable timber are in some way definitely safeguarded from fire. It is really only a small insurance to pay for permanent supplies of constantly increasing value.

Still another question perhaps arises—Is the produce of the forest used to any very great extent? It must be said that a great deal of waste goes on, though by no means always wantonly. Lack of communication and lack of opportunity debar small sizes from being disposed of. Also a great many hardwoods are so far from any large towns that it is not profitable to extract them, with the exception of yellow birch. This, however, is a matter of development, and with definite cutting arranged, at first perhaps with an arbitrary rotation of 100 years dividing the forest into equal areas to be cut each year, mills in connection with each could be established. This should be of a capacity corresponding to the average annual growth of the forest, or by a diameter limit, with due supervision.

The main points then are, in brief:—

1. Adequate protection to existing forest areas from fires.

2. Conservative cutting, with due regard to the future of the forest, using only the increment, instead of the growing stock.

3. Definite classification of land (agricultural and forest).

4. Schemes of management for existing reserves.

From what has been said above it will seen that these objects are being aimed at, and will in time be accomplished, but as in all things real progress is slow and sure. Those outside the Dominion may rest assured that forestry is not only being talked about but is also being thought about, and to some extent realised in the great land of sunshine and snow, wheat and wood.

In conclusion, I may say that I do not belong to the Canadian Government, and for the views expressed I am alone responsible.

Miscellaneous.

BRITISH TRADE WITH PERSIA.

Mr. H. W. Maclean's (Special Commissioner of the Commercial Intelligence Department of the Board of Trade) report on British trade and enterprise in Persia, has just been published. His conclusions, as condensed in *The Economist*, are far from being pessimistic, and the reasons he adduces for the more rapid growth of Russian than of British trade in the past are by no means discouraging so far as the future is concerned. It is estimated by Mr. Maclean

that within the past decade the foreign trade of Persia has increased to the extent of 20 per cent. The total, as shown by Customs statistics, now exceeds £8,000,000 per annum, the exports being over £5,000,000, and the imports £3,000,000. Of this total, the share of Russia and of the British Empire is no less than £6,000,000. Persia's exports to Russia amount to about £1,500,000 per annum. Five-sixths of these exports consist of raw or agricultural products, and one-sixth of manufacturers, including leather, carpets, and various tissues destined for Mohammedans in Russia. Of the imports from Russia, one-half consists of sugar, one-fourth of cotton tissues, and one-fourth of other manufactures. The exports to the British Empire, on the other hand, amount to about £500,000, and the imports from that source are of the value of about £2,000,000. The exports consist chiefly of raw products, while in the imports cotton yarns and tissues take the principal place, constituting three-fourths of the total British imports and two-thirds of the total imports of these commodities into Persia. Statistics appended to the report indicate that the total imports from the United Kingdom are more than double the value of those from India, the respective totals being £1,290,377 and £638,891.

Russian trade, Mr. Maclean points out, has shown a very marked increase in recent years, whilst British trade shows neither marked increase nor decrease. This, he observed, has been frequently commented on, and may have acted as a deterring influence to British enterprise in Persia. The report, however, proceeds to indicate that the real reason for the state of things described lies in the fact that the most cultivated, populous, and prosperous provinces of Persia lie nearer to the Caspian than to the Persian Gulf, our commerce, therefore, having to penetrate far inland to arrive at the best markets. The conquest of Transcaspia, writes Mr. Maclean, enabled the Persian Province of Khorassan to devote itself in security to the development of its natural resources, and the opening of the Transcaspian railway provided an outlet for the products of the soil, which could not have been remuneratively carried to the Gulf. In the meantime, the industrial centres of Russia, formerly more distant from Persian markets than we were, have, through improved steamship and railway communication, been brought gradually nearer to these, and Russian merchandise now reaches the markets of Northern Persia within three months or less of the date of the order, whilst our own goods require five or six months for the same journey.

Russia, moreover, has sought to extend the importation of her manufactures into Persia by means of shipping subsidies. the line running from Odessa to the Persian Gulf receiving £4,000 per trip and reimbursement of the Suez Canal dues, payments which give the Russian shipper an advantage over his British competitor of 12s. to 15s. per ton weight on cotton goods at Bushire. Further, the Banque de Prêts de Perse, which, is connected with the Russian State Bank, has devoted itself to the development of Russian trade, especially in textiles, and, according to Mr. Maclean, this institution delivers goods to clients at prices that old-established traders in Persia have been unable to compete with. Drawbacks again, are granted in Russia on certain commodities exported to Persia, one result of which is that in the latter country tea, sugar, kerosine, prints, and calicoes are cheaper than in the Russian markets from which they are supplied. Imports from Persia, too, are greatly favoured by the Russian tariff.

Mr. Maclean, in dealing with the question as to why the regions of Southern Persia accessible to our trade have not developed so rapidly as the Northern Provinces, declares that Luristan, Bakhtiariland, and Arabistan, while possessing well-watered and fertile lands, are not very amenable to the authority of the central Government, and until order is more firmly established little industrial or agricultural progress is, in his opinion, to be expected. In regard to the problem of competition with British goods, he observes that sugar forms quite one-half of the total imports into Persia from Russia, and that a decrease in the supply of this commodity from Russian sources would have given place to an increase from France and Austria, and not from British possessions. If sugar be eliminated, he adds, Russia's relative progress in the import trade will appear much less striking. It is in cotton that we have felt her competition most severely. Our tissues, we are told, have to some extent been driven out of the Northern markets, and the fact that there is no marked decrease in our import trade must be attributed to an expansion of consumption in other parts of the country.

Mr. Maclean has arrived at the conclusion that Russian prints have not established a distinct ascendency beyond such Northern markets as Tabriz, Kazvin, Teheran, and Meshed, and, in his view, it may be questioned whether the trade in these articles really affords an adequate margin of profit. It has, however, been pressed most vigorously, and both Russian and British authorities have expressed the belief that it has been carried to excess, and that the accumulated stocks are beyond the requirements of the market. On a general view of all the circumstances, Mr. Maclean ventures the opinion "that the impetus given to the trade of other countries in Persia must already have produced nearly its full effect, and that our trade, which has survived this competition without any serious detriment, may expect to share many extensions of markets, arising from the increase of wealth and population or from the greater consumption of foreign commodities in Persia." But, while he considers the prospects are encouraging, and furnishes particulars of the branches in which commerce is likely to be remunerative, the Commissioner emphasises the fact that there are already many British traders in Persian centres, and suggests that the prospects of any projected new venture should be

carefully inquired into before they are carried into effect. The question of transport is, of course, of vital importance as bearing on the increase of British trade. The freight on a ton of piece goods from Manchester to Bushire is about £2 5s., and on the inland journey from Bushire to Ispahan, £10 to £11. An improvement, then, in the conditions under which British goods are landed at Gulf ports, and forwarded thence to inland destinations is, in Mr. Maclean's opinion, one of the greatest benefits which could be conferred on our trade with Persia.

PRODUCTION OF CASTOR OIL.

The castor oil plant (*Ricinus communis*) is a native of all warm countries. It is very hardy and will thrive on almost any soil and in any situation, attaining a great height in one season after sowing the seed. The plant likes dry soils. The seeds should be sown in rows, 6 ft. apart and 4 ft. in the rows. Before sowing, the seed should be steeped in hot water for twenty-four hours. After the plants are above ground, the cultivation is the same as for corn, cotton, or tobacco.

When the seed-pods are ripe, they suddenly burst open and scatter the seeds in all directions. Special arrangements must, therefore, be made for harvesting them. When the pods are seen to be turning brown, the spikes which bear them are cut off and taken to a clean-swept piece of hard ground which may be enclosed with galvanised iron. Here they remain, being turned occasionally until the pods have emptied themselves. The husks are then removed by winnowing, and the beans swept up and bagged. They must on no account be allowed to get wet. This work is so light that it can be done by young children.

According to the *Queensland Agricultural Journal*, quoted in the *Pharmaceutical Journal*, the yield of beans varies between 20 and 30 bushels per acre. The oil is extracted by means of a hydraulic, a screw, or a lever press. What is known as "cold-drawn castor oil" is that obtained by mere pressure. The first thing to do is to remove the external hull. This is effected by passing the beans through two revolving rollers, set in such a way as merely to crack the hull, which is then got rid of by winnowing. The decorticated seeds are then put into coarse hempen bags about 2 ft. in diameter. Between each layer of bags there is placed a steel plate, and about 20 or 30 bags, each holding about 40 lb. of seeds, are placed on top of each other in the press. The pressure must be applied gradually, and the oil running from the first press is the best. As the pressure is increased up to the full power of the press a second quality is produced. The pulp after this is taken out, mixed with hot water, and again pressed to obtain the third quality. The oil from the mill runs into a receptacle below. Another method is to place the beans in a stone roller mill. This consists of two large round stones connected by a spindle, which are revolved by horse-power in a hollow round stone, in which the beans are placed. These stone mills hold about 2 cwt., and this quantity is crushed every half-hour. The oil is poured into filtering bags, and the pure oil runs from the shelves on which the bags are placed through tubes into vessels placed to receive it. The yield of oil varies from 40 to 60 per cent., but the average yield is usually 40 per cent.

The oil cake makes excellent manure. The usual price of castor oil for lubricating purposes—not medicinal—is from 2s. 9d. to 3s. per gallon. From 1,000 lbs. of seed about 50 gallons of oil are produced. Thus, if the produce of one acre of castor oil plants is 1,000 lbs., the return would be £7 10s. But this is merely an approximate return, which must necessarily vary under different conditions. The first oil expressed—that is that known as "cold drawn"—is the medicinal oil, which sells at a much higher price than the second and third qualities.

LACE-MAKING IN BELGIUM.

The excellent quality and workmanship of the Brussels lace is world renowned, and while it is known as Brussels lace that article is not manufactured exclusively in the Belgian capital, but at different places throughout the country. While the article retains its high value, the manufacture as a trade is on the wane. In 1875, those employed in the manufacture of this lace were estimated at 150,000 throughout the whole kingdom. In 1895, the census showed that only 47,571 persons were so employed, of whom more than 25,000 were located in West Flanders. It is estimated that in and about Brussels, including Malines, and other parts formerly known as the lace zone, there are not over 250 now engaged in lace-making. In 1881, at Bruges, there were 6,000 persons employed in this industry, while the census of 1896 showed only 3,394. The trade is gradually drifting to East Flanders, where the land is said to be poor, and the people take it up during the winter months particularly, being content with the small compensation it affords. The rise of other industries, such as glove-making, shoe factories, match and tobacco factories, weaving mills, chemical works, and other industries offering better wages, have drawn away the lace makers, who not only find that that trade entails more work and responsibility than employment in the above-mentioned industries, but it affords less compensation.

Correspondence.

BRITISH VERSUS FOREIGN PATENT LAWS.

When I wrote on this subject in the Society of Arts *Journal* of 26th February last, I quite expected to see a rejoinder from an official of the United States

Patent Office in defence of the system adopted by that office, but I was not quite prepared for a flat denial by two of those gentlemen of the existence of the four rules mentioned by me in my former letter as operating prejudicially against the inventor. I regret that, notwithstanding that denial, I must reaffirm most positively that they do exist, not, it is true in black and white, but in the practice of the examiners. It is true that one of these rules, namely that relating to the inclusion of method claims in a patent for apparatus, has been set aside by a recent decision, but at the time when I wrote they were all in full force.

I have had the pleasure of fighting the United States Patent Office examiners over my clients' inventions for the last forty-five years; up till within the last twenty-five years, or so, the requirements of the Patent Office were reasonable enough, and it was no very difficult matter to get the patents allowed with claims satisfactory to the inventor. It is only since then that the various restrictions alluded to by me have been enforced with gradually increasing strictness. As an example of this I may mention that in the year 1877 I was able (it is true after some fighting) to get the Patent Office to allow a good method claim in the well known "Otto" gas engine patent (U.S. Patent No. 194047) together with the claims for construction.

Now, as to the existence of the said rules, as an ounce of fact is worth more than a ton of arguments and general assertions, I will give particulars of the action of a United States Patent Office examiner in a case which I had in hand some two years ago, also relating to an internal combustion engine in which was involved a novel method of action, and it will be seen that this fully bears out my statements.

In the claims originally filed with this application I included some which set forth not only the essential features of construction of the machine, but also the novel method of operating carried out thereby. I well knew that these claims would be objected to as being "functional" as the examiners call it, but as my clients were loth to go to the expense of a separate patent for the novel method unless forced to do so, I framed the claims in that manner with a view to an ultimate division.

As expected, I received in due course the examiner's letter to the following effect:—"The claims are objectionable and functional . . . and are rejected." The claims in question were then re-drafted so as to limit them to the construction of the machine, and on the advice of my Washington agents, who were conducting the case, separate claims for the method of operating were added. As was anticipated, the following further objection was received from the examiner:—"The recent amendment has not been admitted, since it presents both claims for a process and claims for an apparatus."

Acting on my advice, my clients then decided to apply for a separate patent for the method of operation. After various communications had passed between the examiner and my representatives at Washington upon the question as to whether there was a patentable method involved or not, the examiner finally refused the application, stating:—

"It is still thought, particularly in view of the Supreme Court decision in Busch *v.* Jones, that the alleged method presented by the claims is the mode of operation of the apparatus employed."

The examiner also refused the application on the ground of an alleged anticipation by a prior patent. My clients then appealed against this decision before the Examiners-in-Chief, who reversed the examiner's decision on both points, and the patent was thereupon granted. As the Examiners-in-Chiefs' ruling on the question of the method claims being patentable is of considerable interest to inventors and patentees generally, I will quote it here:—

"The question whether there is or is not a true process in these claims is determinable by the answer to the question whether there is any force operating to effect the result, other than the force of the mechanism employed (see 'Busch *v.* Jones,' 990 G. 206). If the answer be no, there is no such process. If the answer be yes, then there is a process.

"In these claims there are two forces which are not those of the apparatus merely; first the force of a necessary body of water operating on a gaseous body to compress it, and second an expanding force of those gases, when expanded, operating on that forcing body of water. There are two forces co-operating, neither of them the force of the mechanism, to perform the useful result of the procedure and these two non-mechanical forces operate on each other. It follows that the claims express an art in the meaning of the statute."

Now, in the above case we have clear proof of the existence of three of the "rules" referred to by me.

Firstly, the examiner refused the original claims, because they were "functional," *i.e.*, they set forth not only the construction of the machine, but also the manner in which it operated, thus establishing the rule that "a claim for the construction of a machine must not set forth the manner in which it operates."

Secondly, the examiner declined to consider the amended claims, because they were claims both for the apparatus and for the method of operating, thus establishing the rule "that you could not (at that time) in one and the same patent include a claim for a machine and one for the method of operating involved therein." (This rule, as above stated, has now been declared *ultra vires.*)

Thirdly, the examiner denied that there was a patentable method involved, because the alleged method was, in his view, nothing more than the working of the machine, thus clearly showing the rule "that a claim for a method of operating must be entirely independent of any construction of apparatus." With regard to the fourth rule as to the exclusion of claims for modification in one and the same patent, of course it is well known, as stated by Mr.

Darby, that you can *describe* any number of modifications of an invention in one and the same United States patent, and that if you can formulate a generic claim that will cover a main feature common to all modifications these are covered by the patent to that extent, but the special constructions of those modifications are *not* covered, and should at any time the generic claim have to be cut out of the patent, those modifications, which may be of considerable value in themselves, are lost to the patentee, and therefore, in order to properly secure them he must take out a separate patent for each distinct modification.

But I must now leave the question of these rules, to draw attention to the most serious feature of the practice of the United States Patent Office exemplified by the above mentioned case.

Not only were my clients obliged by the action of the examiner to go to the expense of applying for separate patent application for the new method of operating involved in their apparatus, but they were forced to go to the further considerable expense o appealing against his decision to the effect that there was no potentable method involved. Now, had my clients been of limited means, or had they not been properly advised, they would probably have accepted the examiner's decision, and would thus have been deprived of the most valuable part of their invention. And this is no doubt what occurs in a large proportion of similar cases in the United States Patent Office.

Mr. Darby says, that when a United States patent issues "the inventor or owner secures a grant which carries with it the presumption of novelty . . . . . a grant sustaining such a legal presumption is of the utmost (?) value to the inventor." That may or may not be the case, but I say that such a grant also carries with it the possible presumption that the pith and marrow of the invention has been knocked out of the patent by the action of the examiner, and that the commercial value of the patent, though possibly valid at law, may be *nil* as compared with what it might have been without the interference of the examiner.

I maintain therefore that the system as carried out in the United States, Germany, and unfortunately, in several other continental States of putting the power into the hands of an examiner of deciding what is and what is not a patentable invention, is most detrimental to the interests, not only of the inventor, but also of the manufacturer, and it would in my opinion be a bad day for English patentees and manufacturers if that system were ever adopted in this country.

The proper function of a Patent Office examiner is to take care that the patent specifications properly and completely describe the nature of the invention and the manner in which it is to be performed, and that there shall be no misleading or incorrect statements therein; also, he should carefully examine the prior patents and advise the inventor of those which in his opinion more or less anticipate the invention; also, if it be held by the head of the Patent Office after due argument that the invention is in his opinion more or less anticipated, the patentee should be obliged to mention the alleged anticipating patents in his specification, so that an intending purchaser or licensee would be enabled to use his own judgment, aided if necessary by his professional advisers, in deciding on the value of the patent.

Now, as regards the first above-named function of the examiner, this in my opinion is carried out in a very perfect manner by the Patent Office of this country; much more so than in the Patent Offices of either the United States of Germany. In the German patents one continually comes across specifications of the most slipshod description that have been passed as sufficient by the examiner, wherein the invention is not half described, and in which, particularly as to the drawings, there are glaring inaccuracies. In the United States patents, on the other hand, one frequently meets with specifications that more or less completely describe the construction of a machine even to the minutest details, but in which a clear description of the mode of action of the several parts described is entirely wanting. No doubt Mr. Darby would say that this is entirely unnecessary, because, having described the construction of the machine or apparatus, the mode of action follows as a matter of course, and does not require to be described. On this point I beg to differ from him in toto. The fact is that he, like the examiner in the above-mentioned case, cannot get into his mind that there may be cases which do not come under any one or other of the four classes which he enunciates; he can only conceive a machine that carries out a certain operation or process of manufacture, which machine on being set in motion, must necessarily perform that operation, and hence he says:—"A process or method within the meaning of the United States Patent Laws must be independent of the necessary operation of any special construction of machinery for carrying that process into operation or else be an inherent principle of the mechanism itself, in which event it is no longer a process or method but the function of the machine which is inherent in the machine, and which is brought into operation every time the machine is operated."

I am glad that Mr. Darby has made this didactic statement, because it quite confirms my opinion that the United States examiners, with all their cleverness, are incapable of appreciating the peculiarities of inventions that do not come under the hard and fast rules and classifications laid down by the Patent Office.

Both in the "Otto" gas motor patent and in the invention I have above referred to there *was* a new method of operating which was *not* an "inherent principle of the mechanism itself," and which was, nevertheless, dependent upon the main features of the mechanism for its action, and, as will be seen, the Examiners-in-Chief fully recognised the existence of that new method.

But to return to the question of the proper

functions of the Patent Office examiners. I have no doubt that when our Patent Office is fully organised for carrying out the system of examination according to the Act of 1902, the examiners will perform that duty as efficiently as they now carry out their present duties, and will not resort to the objectionable practice of the United States' examiners, who, when a case comes before them, instead of carefully examining the prior patents on the same subject, and only drawing the applicant's attention to those that really touch upon his invention, pick out all patents that even remotely bear upon the subject, and practically say to the inventor, "I consider that all these patents anticipate your invention; prove to me that they do not," whereupon the unfortunate applicant, or his agent, has to wade through perhaps some dozen patents in order to find that possibly one-half of them have nothing whatever to do with the invention at all, and that none of the others constitute any anticipation of it.

Mr. Darby, with his ten years' experience as a Patent Office examiner, is good enough to instruct me as to the proper way to set to work to draw efficient claims for the United States Patent Office. I may inform him that I have succeeded in getting efficient claims allowed in the United States' Patent Office in the teeth of the examiners' objections for the last forty-five years—probably long before he was born—and that when speaking of the rules laid down by the examiners, I did not mean to say that I complied with those rules, but that they were what the examiners tried to enforce.

In conclusion, I would repeat that notwithstanding the loud praises of the United States patent system, sung by Mr. Darby, I am convinced that that system is a wrong one, and that the system most beneficial, not only to the inventor, but to the public at large, and also the most rational one, is that adopted by the Patent Office of this country under the Act of 1902.

CHAS. D. ABEL.

Birkbeck Bank Chambers, Southampton-buildings,
London, W.C.,
July 25th, 1904.

Notes on Books.

THE ARMOURY OF WINDSOR CASTLE. (European Section.) By Guy Francis Laking, M.V.O., F.S.A., Keeper of the King's Armoury. London: Bradbury, Agnew and Co.

Windsor Castle was originally a fortified stronghold as well as a palace, and it contained from the earliest times, an arsenal from which armaments might be drawn in large quantities but it was not a museum, and there is no early record of such a museum although much fine armour must have been preserved at Windsor. In an inventory of the contents of Royal palaces taken in 1547, there is reference to certain pieces sent by the Lords of the Council to John Lindsay, the Kinges Majeste armourer to be received at Windsor from Sir Thomas Wollner, "the Kinges armourer." Charles II. after the destruction caused during the Commonwealth was forced to replenish the then empty guard chambers, and "a large magazine of arms was arranged in most beautiful order."

George IV. made a fine collection of armour which was preserved for a time at Carlton-house, but the creation of the Windsor Armoury as a museum of armour and arms is due to the Prince Consort, about the year 1842. It is, however, owing to the initiative of the King that the present fine collection in the north corridor has been arranged. The superb Rondache, long-known erroneously as the Cellini shield, is not found described in the collection of George IV., and Mr. Laking is of opinion that this magnificent shield came into the Royal collection as late as the second quarter of the 19th century as a purchase by the Prince Consort. This very handsome volume contains a full catalogue of the European section of the Windsor collection, and a large number of very beautiful illustrations.

PORTRAITURES OF JULIUS CÆSAR. By Frank Jesup Scott. Longmans, Green and Co. 1903.

Mr. Scott has brought together, within the covers of a single volume, a collection of reproductions of most of the busts and statues that have any claim to be considered as representing the great Cæsar.

The author tells us how the study became an engrossing hobby, and how, in the course of four or five years, he visited all the great museums of Europe, as well as many private art collections, to search for, and to compare, all the materials that have come down to us which may throw any light on the features and head of Julius Cæsar.

At first he was astonished that portraits so dissimilar should be judged by competent authorities to be of the same person, but after a careful study of these works he came to the same conclusion.

He says of Cæsar's portraits: "At first we are confused by the diversity of types, those which personate him in one museum differing so much from some which do the same duty in another museum. But when all are seen and studied, notwithstanding their differences, we find a relationship so clearly indicated by their traits that it is reasonable to conclude that they are more or less good or bad portraits of the same person." The author thinks that no satisfactory portrait can be obtained from the coins alone, some of the effigies on them being designed to typify his pontifical office,—the head drapery being more important in the workman's eyes than the features under it.

Busts of Julius are amongst the rarest of Roman antique portraitures, although innumerable replicas

exist of Augustus as well as of succeeding emperors, and Mr. Scott enters at some length into the probable reasons for this. At first the author wished to classify the busts into types, but he found eventually that they blended into each other with so many expressions in common, though of opposite types, that this method was impossible; in the present work the busts are, therefore, grouped under the heads of the various countries in which they are now located.

The work is well illustrated by 38 full-page plates, and 49 other portrait engravings.

Forestry in the United Kingdom. By W. Schlich, Ph.D., C.I.E., F.R.S. London: Bradbury, Agnew and Co.

Dr. Schlich writes, "Experience in India convinced me that if systematic economic forestry were to become an enduring thing in India and in the Colonies, it would be necessary to make it so in the mother country. When forestry in Britain has once become an essential part of the industry based upon the soil, those who go out to govern the British possessions beyond the seas will be duly impressed by its importance."

In accordance with this view the author has compiled an essay containing the results of lectures and papers given before the Society of Arts, the Royal Agricultural College, Cirencester, and at Carpenters'-hall, &c. The subject is treated under three divisions :—

1. The importance of the forestry problem to the nation.
2. The measures which should be taken in this country to insure the benefits offered by forestry.
3. The afforestation of surplus land and the treatment of some types of British woodland.

Ten illustrations are added to show the natural regeneration of beech, the production of high-class oak timber, and the proper density of spruce woods.

Picturesque Wesminster: Being a collection of sketches illustrating historic landmarks and places of interest in the ancient City of Westminster, arranged and produced by, and under the supervision of, Walter Emden. Illustrations by Howard Penton, and letterpress by G. P. Warner Terry (in portfolio).

County of London: Sketches of Bridges over the Thames. Sketches by Howard Penton, letterpress by Charles Palmer.

The series of sixty-four views of the City of Westminster issued by Mr. Emden form a complete picture of the district, in that it shows both the old and new in the city which extends from the Temple in the east to the Albert-hall on the west, and from Holborn and Oxford-street on the north to the Thames on the south. The sketches by Mr. Penton show the various places in a fresh light, and some of the buildings have not been previously drawn.

The sketches of London bridges show them as they are now, many of them having superseded the old and inconvenient erections, which, however awkward, were more picturesque than those which have succeeded them. Mr. Emden wishes them to be considered as forming a companion volume to "Picturesque Westminster."

Obituary.

Dr. Isaac Roberts, F.R.S., who died at his house at Crowborough, Sussex, on Sunday, 17th inst., had been a member of the Society of Arts since 1874. He was born in Denbighshire, in 1829, and the greater part of his life was devoted to the experimental study of geology, astronomy, and other branches of science. He commenced his astronomical work at Maghull, near Liverpool, but he subsequently removed on account of the unfavourable climatic conditions of the place. Dr. Roberts was the inventor of a machine for measuring the magnitudes and position of the stars. In 1893 and 1900 he issued two volumes of photographs of stars, star clusters and nebulæ, with scientific deductions founded upon them, the results of his important work in astronomical photography. His observations were also published in the proceedings of the Royal Society, and in the publications of the Royal Astronomical Society. From the latter society he received the gold medal in 1895.

Sir John Simon, K.C.B., D.C.L., LL.D., F.R.S.—On Saturday the 23rd inst., Sir John Simon, Medical Officer of Health to the Privy Council from 1858 to 1876, died at his residence in Kensington-square. He was born in London on October 10th, 1816, of Anglo-French descent, his grandfathers who were both Frenchmen having married English wives. In 1833 he entered the medical profession, and in accordance with the custom of the day he was placed as a pupil with the late Mr. Joseph Henry Green, then Surgeon to St. Thomas's Hospital and Professor of Surgery at King's College. He became a member of the Royal College of Surgeons in 1838, and he was elected a Fellow in 1844. In 1840, on the opening of the new King's College Hospital, he was appointed Assistant Surgeon. In 1847 he became Professor of Surgery at St. Thomas's Hospital. In 1848 he was appointed Medical Officer of Health to the City of London, a newly constituted post which he held until 1855, when he was made Medical Officer to the General Board of Health. Simon surrendered his growing private practice as a surgeon on his appointment in 1878, as Medical Officer to the Privy

Council, although he stipulated for permission to retain his appointment as surgeon to St. Thomas's Hospital. On his retirement in 1876 he was appointed a crown member of the General Medical Council and was made a C.B. He was President of the Royal College of Surgeons in 1878-79, and Vice-President of the Royal Society in 1879-80. At the Jubilee of 1887 he was made a K.C.B. He was elected a member of the Society of Arts in 1876, and held the office of Vice-President in 1877-78. The Sanitary Institute published in 1887 two volumes of his Public Health Reports under the editorship of Dr. Seaton, his successor as Medical Officer to the Privy Council and the Local Government Board. He, himself, issued in 1890, a work on "English Sanitary Institutions reviewed in their course of development and in some of their political and social relations." In an appreciation of Sir John Simon's distinguished career, quoted in *The Times* obituary, he is described as "the master of sanitary science, the organiser and for years the official head of a system of public health preservation which is without equal in the world, the philosopher whose teaching has saved the lives of hundreds of thousands of our people, whose name is a household word wherever preventive medicine is studied, and whose writings form the classical literature of the subject to which much of his life has been devoted."

General Notes.

Semmering Railway.—The fiftieth anniversary of the opening of the first mountain railway was recently celebrated in Vienna, and in the neighbouring mountain resort, Semmering. The line over the Semmering, 3,300 ft. high, was projected and carried out half a century ago by Karl Ghega, an Austrian engineer.

Royal Mint.—The thirty-fourth annual report of the Deputy-Master and Comptroller of the Royal Mint for 1903 states that, as compared with the previous year, there was a considerable decrease in the number of Imperial coins struck during 1903, owing to the much smaller demand for silver and bronze currency. The gold coinage, however, was unusually large, being nearly £4,000,000 above the average of the previous ten years. The number of coins issued for circulation in the United Kingdom in 1903 was 3,063,322, comprising 700,702 of the larger denominations — 5s., 2s. 6d., 2s. — and 2,363,620 of the smaller—1s., 6d., 3d.—or 22·87 and 77·13 per cent. respectively of the issue. The total number of silver coins issued during the year, excluding Maundy money, was 14,694,402, of the nominal value of £556,851, as against 23,658,862, of the value of £936,806 in 1902.

Discoverer of Coal Gas.—Reference was made in the *Journal* on July 4th, 1902 (Vol. 50, p. 690) to the proposal to erect in Holland a monument in honour of Jan Pieter Minckelers, the supposed discoverer of coal gas. The statue in the market place at Maastricht was unveiled, on Sunday, 10th inst., by Heer Ruys de Beerenbroeck, the representative of the Queen of Holland in Limberg. The occasion taken for the ceremony was the 32nd meeting of the Dutch Association of Gas Managers. The statue is the work of Heer Bart von Hooe. The following details respecting the life of Minckelers, are taken from a biographical notice compiled by Heer Bolsius, President of the Association, as reported in the *Journal of Gas Lighting*. Jan Pieter Minckelers was born in the year 1748, belonging to an old family, and was, it is believed, primarily educated for the priesthood. His natural bent, however, caused him to choose another sphere of activity, and he went to Louvain to study natural science, and when only 24 years old, in 1772, he was a Professor of Physics, and occupied the Chair in the University. It appears that the question of balloons was engaging public attention at the time; and it was in the endeavour to discover a substitute for hydrogen that, in 1784, Minckelers announced that he had succeeded in obtaining a gas from the distillation of powdered coal, which answered the purpose, and which he called "inflammable air." This is the date of the discovery by Minckelers of lighting gas, although he did not utilise it for this purpose until 1785, when, according to Heer Bolsius, there is good authority and authentic documentary evidence that he succeeded in lighting the class room at Louvain University. Minckelers lived until 1824, when he died at the age of 76. Frenchmen will naturally compare these dates with that on which it is claimed that Philippe Lebon made gas; and this has been stated to have taken place in 1791. But it was in 1798 that Lebon communicated his invention to the Academy; and his first patent is dated 1799. Englishmen will naturally look to William Murdock. But Heer Bolsius says that the commemorative stone fixed to the house inhabited by William Murdock at Redruth, mentions that Murdock invented gas in 1792. This appears, however, to be the date when he commenced making experiments on the illuminating properties of gases produced by distilling coal, wood, peat, &c. He received the Rumford Gold Medal of the Royal Society in 1808 for his paper in the *Philosophical Transactions* containing an account of his investigations. There does not appear to be any reason for doubting that Minckelers, Lebon, and Murdock, conceived, carried out, and perfected the manufacture of coal gas by quite independent investigations, and without knowledge of what the others were doing. It should here be stated that the public acknowledgment of the work of Jan Pieter Minckelers has been carried out through the endeavours of Mr. Bolsius, and also the Committee appointed in 1898 under the auspices of the town of Maastricht.

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

PRACTICAL EXAMINATIONS IN MUSIC.

The practical examinations in Music were not concluded this year until the 7th July, too late for the results to be included in the Report of the Council. They lasted for 15 days.

The examination was conducted by Mr. Ernest Walker, M.A., Mus.Doc.Oxon., and Mr. Burnham Horner.

The system of examination was the same as that for recent years. For instrumental music certain standards are given, and candidates are asked to select for themselves which of these standards they choose to be examined in. The standards range from easy to very difficult music. For each standard a list of music is given for study, and from this list candidates select the pieces they will sing or play. Candidates are expected to play or sing the pieces which they have prepared, to play or sing a piece, or portion of a piece, at sight, and to play certain scales.

In all, 578 candidates entered, and of these 557 were examined, an increase of 71 as compared with last year. There were 407 passes and 150 failures.

The following were the subjects taken up:—Piano, singing, violin, violoncello, and viola. 466 entered for the piano, 342 of whom passed; 68 entered for the violin, of whom 52 passed; 2 entered for the violoncello, both of whom passed; 20 entered for singing, of whom 10 passed; 1 entered and passed for the viola. No medals were awarded.

The Examiners report that the candidates varied a great deal in quality; many gave abundant evidence of excellent teaching, but many on the other hand showed very inadequate training in touch and tone, and were unsafe in technique.

Miscellaneous.

PHYSICAL DETERIORATION.

The Inter-Departmental Committee on Physical Deterioration, which was appointed by the Duke of Devonshire, as Lord President of the Privy Council, on the 2nd of September, 1903, and was instructed "to make a preliminary inquiry into the allegations concerning the deterioration of certain classes of the population as shown by the large percentage of rejections for physical causes of recruits for the Army and by other evidence, especially the report of the Royal Commission on Physical Training (Scotland), and to consider in what manner the medical profession can best be consulted on the subject with a view to the appointment of a Royal Commission, and the terms of reference to such a Commission, if appointed," has now issued a long and elaborate report, which has been published as a Blue-book [Cd. 2175]. The Committee was under the chairmanship of Mr. Almeric Fitzroy, Clerk of the Council, and comprised Colonel G. M. Fox, Inspector of Physical Training under the Board of Education; Mr. J. G. Legge, Inspector of Reformatory and Industrial Schools; Mr. H. M. Lindsell, C.B., Principal Assistant Secretary to the Board of Education; Colonel G. T. Onslow, C.B., Inspector of Marine Recruiting; Mr. John Struthers, C.B., Assistant Secretary to the Scotch Education Department; and Dr. J. F. W. Tatham, F.R.C.P., of the General Register Office; Mr. Ernest H. Pooley, barrister-at-law, being secretary. The original terms of reference were subsequently explained and enlarged, and the Committee was directed—"(1) to determine, with the aid of such counsel as the medical profession are able to give, the steps that should be taken to furnish the Government and the nation at large with periodical data for an accurate comparative estimate of the health and physique of the people; (2) to indicate generally the causes of such physical deterioration as does exist in certain classes; and (3) to point out the means by which it can be most effectually diminished." In pursuit of these objects the Committee sat on 26 days for the purpose of hearing evidence, and they examined 68 witnesses from England, Scotland, and Ireland.

With regard to the first of these questions, the Committee are unable to discover any trustworthy evidence of the general or extensive physical degeneration which by some has been supposed to exist.

Under the second head, the Committee declare "that the impressions gathered from the great majority of the witnesses examined do not support the belief that there is any general progressive physical deterioration," and they then enter into some detail with regard to the great improvements in public sanitation by which the probability of such deterioration has been diminished, although they are constrained to admit that in large classes of the community there has not been developed a desire for

improvement commensurate with the opportunities offered to them.

The third part of the report is devoted to a summary of the principal recommendations which the Committee desire to make, and amongst these are the organisation of a permanent Anthropometric Survey; the establishment and maintenance of a Register of Sickness not confined to infectious diseases, and the creation of an Advisory Council, representing the Departments of State, within whose province questions touching the physical well-being of the people fall, with the addition of members nominated by the medical corporations and others, whose duty it should be, not only to receive and apply the information derived from the Anthropometric Survey and the Register of Sickness, but also to advise the Government on all legislative and administrative points concerning public health in respect of which State interference might be expedient; and to them might be remitted for consideration and report all the problems affecting public health which the requirements of a complex social organisation are constantly bringing to the front. Such a Council, the composition of which might be modelled to some extent on *Le Comité Consultatif d hygiène publique de France*, would be, the Committee believe, of great assistance, especially to the Local Government Board, and would be calculated to supply the knowledge and stimulus which are necessary in order to give to the Public Health side of the Board's administration a prominence which the multiplicity of its other functions may have tended to obscure, and to attract to its work that measure of public interest and support which has perhaps been lacking hitherto.

Other subjects referred to in these recommendations are over-crowding, labour colonies and public nurseries, building and open spaces, smoke pollution, register of owners of houses, law as to insanity and overcrcrowded house property, medical inspection of factories, alcoholism, food and cookery, adulteration, infant mortality, milk supply, feeding of infants, training of mothers, games and exercises, special magistrate for juvenile cases, juvenile smoking. teeth, eyes and ears, vagrancy, &c.

The Committee hope that the facts and opinions they have collected will have some effect in allay-allaying the apprehensions of those who, as it appears on insufficient grounds, have made up their minds that progressive deterioration is to be found among the people generally. At any rate the committee believe that their labours will result in giving matter for reflection to those who realise the importance of evidence towards the determination of issues of such uncertainty and complexity, and that these persons, who they would fain hope are the larger portion of the thinking community, will await the necessary steps being taken to secure that body of well-sifted and accurate information, without which it is impossible to arrive at any conclusion of value as to the general problem.

HAND WEAVING INDUSTRY OF INDIA.

Mr. J. W. Coombes, Deputy-Superintendent, Reformatory School, Chingleput, in an article on this subject, says that in view of the universality of machinery, we are apt to overlook the ingenuity, thought, and skill displayed in the simple appliances used by Indian artizans in the manufacture of goods for their requirements. If the native weaver is to be educated to the point of appreciating the valuable machinery of Western countries, a start must be made from the rung immediately above his own ground level. A machine is as far above his loom as the West is from the East, and it is only by bridging the gulf by simple and tangible methods that he can be educated to see the benefits of mechanical aids. The power-loom is an object-lesson in itself, illustrating this idea.

The three principal motions in a power-loom are the shedding, the picking, and the beating-up. In the hand-loom, the shedding is performed by pressing the treadles with the feet; in the power-loom the cam is substituted for the feet. In the hand-loom, the picking is done with the arm; in the power-loom, the picking arm, imitating the exact motion of the human arm, accomplishes the operation. The beating-up performed manually on the hand-loom is done on the power-loom by means of a crank. Thus even in details the hand-loom has served as a model for the power-loom. The vibrating-back beam of the machine answers to the resilient action of the rope by which the warp is stretched in a country-loom. Therefore, if any improvement is to be effected in the country-loom, it must be accomplished by the addition of simple mechanical contrivances taken from the power-loom.

To appreciate the progress made in the development of the hand-loom it will be necessary to describe briefly the form of loom now in use by the majority of Indian weavers, pointing out defects where they exist and suggesting remedies for their removal. The principal parts of the loom are the slay, the healds, and the reed. The slay with its reed is suspended by two cords from the roof of the house and the healds by two inner cords. The lower portion of the slay consists of a piece of red wood, two inches thick and almost circular in section, with a groove cut along the top for the reception of the reed. At each end a short upright is fixed, and passes through slots cut in the upper portion of the slay. This is a piece of common close-grained wood, like tamarind, $2\frac{1}{2}$ inches deep and $\frac{3}{8}$ inch thick, with a groove cut in the bottom, to form a cap for the reed, to fix it in a vertical position. In the middle there is a handle, for the weaver to grasp and beat up the weft with great force, after the healds have divided the warp. With this simple form of loom the cloths of the East are woven.

The first mechanical aid to improve the hand-loom is the fly-shuttle. This was introduced by Kay in 1733. One form of it consists of a piece of stout leather formed into a cone to fit over the ends of the

shuttles. This is nailed on the underside of a flat piece of hard wood (rosewood) which slides horizontally in two grooves cut in the box at opposite ends of the slay. A handle communicates with the two pickers and by a quick jerk the shuttle is driven across the loom from one box to the other. In the native loom the shuttle, which is made of light bamboo, is thrown across by one hand and caught by the other and so on. The advantage of one system over the other is apparent, but there are dangers connected with the fly shuttle which should be taken into consideration. The dividing of the warp or shedding motion must be to the same extent each time the shuttle is moved across, for if the warp threads do not lie flat over the race board the shuttle would cut the thread. In the case of the native loom there is no race board and no precaution is necessary to ensure an exact shedding motion for each pick of weft.

The advantage of the fly shuttle becomes more apparent as the width of the loom increases. Mr. Coombes adds—When I was in charge of the experimental weaving shed of the School of Arts I introduce a three-yard loom for weaving lace turbans. These cloths are woven on the native loom by two weavers, because of its breadth; whereas, on the fly shuttle loom, one weaver is sufficient, and the operation of weaving is quicker.

The native-made Indian cloths are characterised by elaborate borders and cross borders or headings. These elaborate and solid borders cannot be woven on the fly shuttle loom; but by the use of special healds knitted for the particular border, a simple and figured border can be woven by a dobby (cost Rs. 3) placed above the loom.

I am tempted to refer here to the power-loom that has been patented to weave these solid bordered goods, turning out from 60 to 70 yards of cloth per week of 56 hours. The border has a separate beam and a separate shedding motion. The inner last thread of the border is thick, and is wound on a separate reel. This thread is bound to the neighbouring end in the body of the cloth by the weft of the border, and is worked by a swivel. In native goods, the two weft threads interloop with each other; in English goods of this class, two adjoining warp threads are interlooped, and if one of these threads break the border separates from the body. If this defect can be overcome the native weaver will certainly be a sufferer from competition.

The second improvement that should be introduced in hand-looms is the use of English healds and reeds; because they reduce the breakages of ends, and produce an even texture in the cloth. Healds are intended to divide the warp, which is technically known as shedding. The native healds consist of a series of loops linked together, the warp threads being drawn through the space formed by linking two heald loops. Excessive breakage of ends is likely to result from forming sheds with these clasped healds, because they nip the warp and prevent it from making any sliding movement. Moreover, after a certain quantity of cloth is woven, the weaver has to push back the healds, which should always remain at a distance of 8 inches from the last pick inserted, and with clasped or native healds this operation tends to break several ends. It seems strange that the simple remedy eventually adopted should have escaped the notice of so many generations of skilled workmen in this country. In English or mailed healds, an eye is inserted between the two loops for a warp thread to pass through, and to move in without being strained.

The reed is used to beat up the weft, and the Indian weaver makes it of very fine slit bamboo. These reeds are defective, for the number of dents in each inch varies slightly, and the spaces between the dents are not quite equidistant, the result being that the cloth woven is "reedy" and uneven in texture. In an English reed the dents are made of flattened brass or iron wires, which are fed into a machine that automatically cuts it into equal lengths, and inserts each in position with a definite number of dents on a given length.

At the first, some difficulty may be experienced by those accustomed to the use of native healds and reed, as to what count of reed and healds would be required in the English system for a particular class of cloth.

The following Table suggests how one system of counting may be converted into the other. Comparing

English System.		Indian System.	
Stockport Reed.	Dents in each.	A Section = 60 dents.	
80's	40	24 sections	in. 1 yd.
72's	36	22 ,,	,,
60's	30	18 ,,	,,
40's	20	12 ,,	,,
20's	10	6 ,,	,,

the cost of a set of English reed and healds with that of a country made set, the former is about two-and-a-half or three times as much, while the life is three times as long, so that the advantages of English-made reed and healds are self-evident.

For the fly shuttle adapted to native looms, the depth of the healds is 8 inches and for frame looms, the depth is 10 inches for a clear shed.

The next improvement to be added is the beam and its flanges. In the native system, the warp is rolled into short lengths and suspended; it is seldom more than 9 feet long. By substituting a beam with flanges, warps of great length can be wound on and this lowers considerably the cost of preparation. The beam should rest in brackets in side posts fixed to the ground.

The fourth contrivance that may with advantage be added is the letting off and taking-up motions. In most frame-looms, a pawl is hinged to the loom framing and rests in the teeth of a ratchet on the

warp beam and it has a cord attached, which by pulling disconnects the pawl and the wheel: hence the weaver could draw the warp forward without leaving his seat. The defect of this system is the continual increasing strain put upon the warp so long as the pawl occupied a fixed position. By coiling wo ropes two or three times round the opposite ends of the beam and fastening heavy weights to the outer and light balance weights to the inner ends of the ropes, a superior method of controlling the warp is obtained, for ropes and weights reciprocate with the shedding motion. In weaving, some means must also be adopted to draw the fabric regularly forward as it is woven. This is called the take-up motion. It is difficult to devise a good form of this motion and the simplest consists of a beam wheel, whose teeth are moved round by a worm wheel fixed to a small shaft. On the same shaft is a toothed wheel with a ratchet, which is connected to the slay and follows its swinging motion. Each time a pick is thrown across and beaten up, the ratchet conveys its action through the wheels to the beam, which rolls the cloth as it gets woven, on to the beam.

The foot power, or "Domestic" loom as it is called, is supposed to be the most perfect of hand-looms, but it is altogether unsuited for this country. In Europe, the outturn is put down at 48 yards a day. But I have never been able to turn out more than 16 yards, and that with coarse counts. Moreover, the reed space is too narrow for most classes of Indian cloths. I believe there is, at Cairo, a factory of these looms working, but only coarse cloths are woven, and the physique of the Egyptians is better than that of the Indian.

Having arrived at the stage of a European hand-loom, the preparation of the warp offers to the Indian the most serious problem for solution. The native system is laborious, defective, and costly, and some form of machinery is required to turn out better prepared and cheaper warps. For a jail, it is easy enough to devise a sizing machine, because the class of cloth woven is generally coarse in texture and of a plain weave; but when we have to deal with counts as fine as 100's and 102's some system as the Scotch form of dressing is essential, and this work can be undertaken only by a friend. My friend, Mr. Kelkar, of Indore, an enterprising Indian, paid a visit to Europe to solve this problem. At Rochdale, he invented a sizing machine, where the drying was performed by plates heated with charcoal fire, thus doing away with steam altogether; but to me the weak point of the machine lies in the fact that the temperature of the plates cannot be regulated. If too hot, the size would cake off the yarn, and if too low the danger is that the yarn is liable to mildew. If the sizing problem be solved, then the warping and beaming are comparatively easy processes.

There is still a future for the hand-loom in India, as there are certain classes of goods which cannot be woven on the power-loom, such as, the "Madras ndkerchief," for which the demand is greater than the supply. If the co-operative system is to be intro duced, why does not some enterprising merchan collect together in one shed a number of weavers wh do this class of work, paying them only for the cos of weaving. At present, the Madras handkerchie obtained by merchants from local dealers is exporte to London in mango wood trunks, and then re-ex ported to Africa, thereby reducing the profit tha ought to go into the hands of the weavers.

The object of the experimental work of the Schoo of Arts was to discover a process of manufacturing th Madras handkerchief, which would give better result than the methods now used by native weavers. A the same time, the character of the "Madras Hand kerchief," which is a definite and well-known term was not to be altered. Its three chief characteristic are—

(1) The peculiar smell. (2) The large holes made in the selvages by the native temples. (3 The bleeding of the indigo dyed yarn. All these would be considered defects in English made goods; but here they are looked for as indispens-able marks to distinguish the genuine from the spurious article. Lancashire has made repeated attempts to take this trade away from the hands of the natives, but to no purpose. As the European hand-loom offered the most probable direction in which improvements could be effected, experiments were carried out to see whether the Madras handkerchief could be woven on it, and I was able to produce a marketable class of cloth by raising the back, beam-boiling the welt, beating up with a closed shed, and weighting the slay. The sizing adopted for the warp was hank-sizing. The yarn was sized in the hank form in farina or potato starch, softened by tallow, and before it was quite dry it was wound on to bobbins and drawn off from thence, through a system of brushes to be warped on the mill—a simple, but effective method. The conclusion is that business in this and other classes of goods can be made commercially profitable, if carried on under proper direction and in a weaving centre and the question of raising the capital should not prove insurmountable.

TIN DISCOVERIES IN THE BUSHVELD.

The following summary of the particulars respecting the discovery of tin in the Bushveld, near Pretoria, is taken from the *African Review.*

Careful exploration shows that the metalliferous veins are confined to a certain part of the granite belt, roughly speaking, ten miles in extent, and having coal measures on either side of it, to north-east and south-west. The lodes strike approximately north and south or across the granite belt, which has its greatest length east and west. The farms acquired by Messrs. Wilson and Brayshaw, which are situate about 35 miles north-east of Pretoria, are as follows:

	Morgen.
Enkeldoorn, five-eighths freehold, three-eighths option of minerals	5,300
Zustershoek	5,000
Klipspruit, portion	2,000
Rietfontein	6,000
Hartebeestefontein, portion	1,200
Total	19,500

The above is equal to some 40,000 acres.

On Enkeldoorn, the farm on which the tinstone as first struck, the veins are most easily followed. hey cut through the granite, which is of the newer iriety, in an almost north and south course, with a end, if anything, to the east and west. There are so cross veins, coursing obliquely, approximately orth-east and south-west, to the main lode—the lode n which working operations are proceeding. The nstone, which is of the nature of quartz porphyry ear the surface, becoming more quartzose in depth, ccurs in walls of fine granite of a few feet in width nly, which is again enclosed by the massive, coarse-rained later red granite, which covers such a large rea of this section of the Transvaal.

Starting from the middle beacon of the boundary ne dividing the two portions of the farms, and going astward, the first vein outcrop is met with about two undred yards from the beacon, and again two hun-red yards further on a second outcrop is passed. Another 1,200 yards eastward the main load is come pon. About a month ago, active opening up work vas commenced on this line at the point where the trike was first made in the road. On the north ide of it, 160 yards above the road, a cutting vas made, and the formation gone down upon. South of the road 140 yards, another cutting has been nade, and the vein sunk upon. Then at intervals over a distance of a mile and a half along the forma-ion to the south, five cuttings, exposing the vein, iave been made, and the last evidence of its outcrop eases within 100 yards of the boundary of the farm. The same lode has, however been located and sampled wo miles further to the south in the nek on Zuster-hoek. To the north the outcrop disappears below he subsoil, as does also the granite, but it appears igain, and it is recognisable on Rietfontein, some even miles away. On the eastward side four other nineralised veins have been located, the nearest of which to the main lode is about 500 yards distant, out their contents and values have not yet been iscertained.

For the last week or two work has been mainly directed to following the reef down in three cuttings, which may best be described as the road shaft, where the strike was first first made, and the cuttings on either side of it, and, oddly enough, so far the best values have been obtained from the road shaft, although it is only fair to say that the real reef body is now being come upon in the other two shafts, the last rock broken out from the north shaft containing a visibly large proportion of cassiterite.

Samples from the road shaft submitted for assay at different periods as the lode has been sunk upon have given the following results: 5·6 per cent. white metal, as mentioned above; 9 per cent., 7 per cent., and 16·6 per cent. But none of these represent anything like the values of the rich stone now being broken out. In the sections where the ore body can be best observed, that is in the deepest cuttings, the outcrop appears to be a mere capping of quartzose rock which becomes more mineralised at depth, but merging into, and mixed with fine grained decomposed porphyritic granite and flat layers of decomposed granite. Near the surface it is not more than 18 in. or 2 ft. in width, but it gradually widens out until a depth of 14 ft. in the road shaft it was 10 to 12 feet in width, and three days later it was practically 20 feet wide at a depth of 17 to 18 feet. The same things occurs in the workings on either side of the road shaft. In the shaft on the north side, two feet below the surface, the reef is about 2 feet wide, and at 12 to 14 feet deep it widens out to some 10 feet. Again, in the shaft south of the road cutting, at surface, it is no more than 12 inches in width, while at a depth of 14 feet the lode matter is 12 feet in width, and bellying out on both sides. The lode seems to be going down fairly vertically; if anything, the tendency is to dip slightly to the east, but with an ore body, each side of which looks like a hanging wall, it is impossible to determine any angle at which it is going down.

Samples taken from upper parts of the lode give an excellent residue of cassiterite, when crushed and concentrated in the pan, but stone broken from the bottom of the shafts gave such really phenomenal and astonishing returns that the bare truth will receive but partial credence. In all probability the records of tin mining do not contain a parallel of such extraordinary values being carried over such a wide ore body.

As with nearly all mining propositions in this country where nature has been bountiful, in the case of the Bushveld tin fields it has been extravagant. Not only has ore of extraordinary richness and in extraordinary abundance been provided, but it is also accompanied by exceptional facilities for working it. The fact of its being located in the Bushveld presupposes an ample supply of timber, but what are of more importance are the splendid streams of water which run through the farms, and the ease with which they may be conserved, which adds greatly to the value of the propositions. Not only is water in abundance on and in the properties, but coal measures over part of one if not part of two farms, while on the farm Nooitgedacht, distant from Enkeldoorn some ten miles, a coal mine is opened and equipped with a working shaft from which coal could be drawn at once. The quality of the coal was proved some years ago, as it was from this mine that coal was supplied for the smelting furnaces at the Albert silver mine.

SUGAR INDUSTRY IN JAMAICA.

The following particulars respecting experiments in Jamaica are quoted in the *Agricultural News* (Barbados).

The following are the details of the scheme for utilising the £10,000 grant-in-aid of our sugar industry which was made by the Imperial Parliament some three years ago.

Eight acres of land, forming part of the property on which Hope Gardens is situated, are to be planted out in seedling canes grown in Jamaica and imported from Barbados and Demerara. At least 2,000 of these will be planted, and from this nursery seedling canes will be distributed to the several sugar estates. The Government sugar expert will be in charge of the nursery, under the direction of Mr. H. H. Cousins.

The present laboratory building is to be doubled. The upper floor will then be converted into an efficient and well-equipped sugar laboratory, which will have a staff of at least three workers. This sugar laboratory will be fitted out with special instruments and labour-saving devices to ensure accuracy and speed in the experiments and analyses to be made. Free analysis of one sample of sugar and one sample of cane juice for any sugar estate will be made during crop times.

In addition to this, a study of sugar and sugar products will be made in the several boiling houses of the island by members of the staff of the laboratory. The lower floor of the enlarged building will be immediately in charge of the Fermentation Chemist. Experiments in distillery will be made, a study of yeast and bacteria undertaken, and in general a detailed study of the chemistry of Jamaica rum.

It is hoped that certain properties will be discovered in our rum by these means, whereby fraudulent sale of other liquors under the name of "Jamaica Rum" will be prevented and the prosecution of the sellers rendered easy. Rum manufacture will also be studied in all its branches on a small scale. The apparatus will consist of a small boiler and engine, a refrigerating plant, a large number of fermenting vessels of 100 gallons capacity, and a small experimental still of 50 gallons capacity, completely adaptable in dimensions, in height of head, retorts and condensing. There will also be a rum store for the storage of rum samples. These samples will be obtained from the several estates in the island and will be experimented on for the purposes of discovering means whereby their quality may be improved. In addition, samples of estate skimmings, molasses and dunder skimming will be obtained from each estate and separately experimented on, rum being manufactured from them. Experiments in improved manufacture will also be carried out on some sugar estates.

The cost of enlarging the laboratory is estimated at £1,000. The machinery will cost £1,000. Another £1,000 will be devoted to the installation or modification of distillery plants on sugar estates.

The cost of running the department will amount [to] about £1,400 a year. £100 a year is to be devoted [to] providing ten scholarships, at £10 each, for the pu[r]pose of enabling distillers and estate book-keepers [to] come to the laboratory for a three-weeks' course [in] the scientific handling of apparatus, &c. It is es[ti]mated that the £10,000 grant will run this depar[t]ment for a period of six years.

A small committee will advise Mr. H. H. Cousin[s], who will be the officer-in-charge of the department.

OPIUM IN PERSIA.

Mr. H. L. Rabino's (British Consular Agen[t]) report on the trade of Kermanshah and district f[or] the year 1903-4, contains the following particulars:—

The opium exported from Kermanshah, *vi[a]* Baghdad, is either got from Nehavend, Malaye[r], Burujird, Luristan, or is produced locally. Opium [is] cultivated in the following districts and sub-districts of Kermanshah:—Hersin, Tang-i-Shohan, Bilava[r], Dinavar, Duru-Faraman, Sar-Firuzabad, and in th[e] vicinity of the town of Kermanshah.

The land intended for the cultivation of opium i[s] cleared and ploughed in autumn, and the seed i[s] thickly sown in the month of Mizan (September 2[3] to October 24). The young plants show above th[e] ground soon after the fields have been watered, an[d] after the end of the cold season, during the month[s] of Hamal and Saur (March 21 to May 22), th[e] ground is manured. The plants are then thinne[d] out, and at the end of the month of Jawz (May 22 t[o] June 22), when the seed vessels mature, the lancing of the poppy heads begins. The lancing is don[e] with a three or seven-bladed knife, and the following morning the juice which has oozed out of the woun[d] is scraped off with a knife. The operation is repeated three times, the plant being allowed a day or two's rest. The quality and quantity of the juice constantly deteriorate. In Isfahan and other places adulteration takes place by scraping away part of the skin of the poppy head, together with th[e] juice (opium thus adulterated is named "pourreh") but I am assured that this does not take place in Kermanshah. Fine weather is necessary to mature the plants, but if at the time of harvest it is very hot and dry the juice will not run so plentifully from the poppy heads, whilst through heavy showers of rain the opium may be lost. The opium is gathered in copper vessels, usually cooking utensils. The following are the expenses for producing 30 maunds tabrizi of raw opium:—

	Expenses. (52 Krans = £1.) Krans.
In autumn—	
10 maunds* of seeds	5
Ploughing, four days	6

* Ten maunds of seed are sown in 1,000 "kards," or rectangles, measuring 3 by 2 zars.

	Krans.
Making the "kards," five days, six labourers, per day	30
Sowing the seed, three days, three labourers, per day	6
Irrigating, four times	12
spring—	
1,000 loads of manure	100
Spreading the manure	5
Thinning the poppies	20
i summer—	
Collecting the opium	150
Total	334

Thirty maunds of raw opium fetch from 180 to 300 omans, 6 to 10 tomans per maund. The necessary unds for the cultivation of opium are generally supplied by the proprietor or lessee of the village, who eceives two-thirds of the crop, and pays the villager, part from all expenses, 10 krans per maund of opium roduced. The white variety of poppy is the one hat is grown. Seed is obtained from the previous rop, and the ground is allowed no rest. Severe cold nay damage or destroy the crop. The usual yield of ,000 kards of land is 30 maunds, but the amount produced may reach 60 maunds. Raw opium is either brought to Kermanshah and sold to the export nerchants, or sold on the spot to pedlars ("jambaz"), who dispose of it in town. The export merchant naving bought, very often maund by maund, a sufficient quanty of opium, stores it in large copper pans, in which the opium is beaten till it is of the necessary consistency, and prepares the drug for export. For export the opium has to be prepared and packed in chests. One chest contains 140 loaves or cakes ("chuneh") of 100 miscals each. The chest contains consequently about 22 maunds tabrizi of prepared opium.

The Luristan opium, being daimi (*i.e.*, not watered), is said to be of better quality than the opium cultivated in the usual way. It is sown by the Kakavan and other Lekk tribes, whose territory borders on that of Kermanshah. The Kermanshah opium is said to be very strong, and is mostly used for local consumption. Pure opium is called "Shirreh." For local consumption opium is prepared in sticks, and is sold at about 17 tomans per maund tabrizi. About 20 kharvars of opium (raw) is consumed locally by the "waffur" smokers. Of the Burujird opium, Mr. J. R. Preece says in his report on the trade of the Isfahan district, 1894, No. 1,376 Annual Series:—"This opium is not used for direct exportation, as it is not very good, being deficient in morphine (on the average it only contains some 7½ to 8 per cent., whilst 10 to 11½ per cent. is the amount admissible for London). It is used for internal consumption, and for adulterating such opium as contains morphine above the required quantity." Good Persian opium contains 12 to 13 per cent. morphine (no such opium passes through Baghdad), and in the London market the price chiefly depends on the percentage of morphine. In Hong Kong the percentage of morphine is not a great factor in the opium market. Kermanshah opium usually contains 8½ per cent. of morphine, and has at the present time a very good name on the Hong Kong market, the adulteration which was practised some years ago having ceased. The expenses for preparing a chest of opium (22 maunds tabrizi) are as follow:—

	Expenses. Krans.
Preparing the opium	40
Paper covers	4
Wrappers	1
Gunny	2
Case	6
Tin lining for case	7
Nails, oil, cloth, rope, etc.	1·25
Total	61·25

To export one chest to Baghdad the expenses are:—

	Expenses. Krans.
Freight to Baghdad	15
Customs duty, Persia	440
Transit duty and expenses, Turkish custom-house	50
Total	505

The expenses on one chest of opium forwarded from Baghdad to Hong Kong are as follows:—

	Expenses.
Freight, Baghdad to Hong Kong	26 rs.
Insurance, Baghdad to Hong Kong	½ per cent.
Landing charges	½ dol.
Commission in Hong Kong	1½ per cent.
Demurrage per chest on the first three months from date of arrival	2 dol.
Demurrage per month afterwards till date of sale	½ dol.
Fire insurance	½ per cent.
Postages and petties, per chest	½ dol.

Usual time between shipment from Baghdad and sale in Hong Kong, sixty to ninety days.

If the chest be sent to London, the following are the expenses:—

	Expenses.
Freight, Baghdad to London	£1 5s.
Insurance, Baghdad to London	½ per cent.
Landing charges	12s. 8d.
Brokerage and commission	3½ per cent.
Fire insurance, London	¼ per cent.
Postages and petties, per chest	1s.
Analysis	14s.

Usual time between shipment from Baghdad and sale in London, 90 to 120 days.

The total amount exported *viâ* Baghdad during the year was 20,422·40 batmans, the total amount for the previous year being 21,840 batmans. At the

beginning of the season prepared opium was offered at 2,600 krans per chest, but buyers held aloof. Prices rose gradually, and in November reached 3,700 krans per chest, at which rate small transactions took place. The greater part of the prepared opium changed hands at 3,400 krans per chest. Of the total amount of opium exported from Kermanshah to Baghdad, 90 per cent. goes to Hong Kong and 10 per cent. finds its way to London and Egypt.

On account of severe frost the prospects of the new crop is very bad.

THE MANUFACTURE OF PEAT BRIQUETTES.

The peat fuel industry has been left to a large extent to individual enterprise, mostly in rural districts of Germany, Netherlands, Scandinavia, Russia, and Ireland, and any statistics that have been issued on the subject are untrustworthy. The use of peat as fuel in Germany dates back to the earliest history of the Teutonic tribes. The peat bogs cover very extensive areas in the northern temperate regions of Europe and America. The German peat area is estimated to be about 11,000 square miles; and peat is utilised for hygienic purposes, for manufacture into paper stock, cardboard, felt, alcohol, &c., for burning in gas generator furnaces, and for manufacture into peat coke, peat slabs, and carbonised briquettes. The manufacture of peat slabs has been practised in a crude way by peasants in the north of Germany and in Holland for more than a century, for the purpose of obtaining a cheaper and more efficient fuel than wood or cut peat. During the past fifty years this industry has been placed on a more intelligent basis, due chiefly to the solution of the problem of a cheap production on a large scale. At the present day machine peat is made which stands transportation and the influences of weather, and in many localities even competes with coal. According to a report by the American Institute of Mining Engineers, the method of making machine peat is entirely automatic, the machinery for cutting the peat, elevating it to the press, and conveying the slabs to the drying ground being mounted on a truck which travels into the bog sometimes under its own steam. This arrangement is made for a capacity of from 50 to 80 tons in 24 hours, and costs from £800 to £1,200 at the factory. The truck travels on rails, and the bog is gradually exhausted by cutting each new trench next to the one just completed. An excavating elevator drops the raw peat into the machine where it is disintegrated, kneaded, and forced through a mouthpiece in the form of an endless plastic band, upon a truck on which it is cut, by a series of adjustable knives, into any desired lengths. The pressure required is very slight, and, as no water escapes, the chemical composition of the raw material is unchanged. The volume of the peat is reduced about one-half, and the slabs when thoroughly air-dried weigh from 40 to 60 pounds per cubic foot. One man is employed for every two or two and a-half tons of peat briquettes produced. While the raw peat contains as a rule between 80 and 90 per cent. of moisture, the air-dried slabs have seldom more than from 15 to 25 per cent. To effect a more thorough drying, large hot air chambers are used. The cost of making machine peat in Germany is from three to four shillings per ton at the outset, which allows a considerable depreciation for the machinery. This figure is taken from the Schilt Works, near Oldenburg, and from the Ranbow Works, near Langen, on the Elbe. There is a peat bog at Magdeburg, which yields annually about £540 worth of machine peat per acre, while the cost of manufacture is but £180, thus leaving a profit of £360 per acre. The average depth of the bog is 40 feet. The experience gained with the use of press-peat as locomotive fuel in Bavaria, Austria, Sweden, Russia, and Ireland, is stated to be very satisfactory. The utilisation of dried press-peat for gas-making and as a substitute for coal and charcoal is also stated to be satisfactory. The problem to produce from a poor grade of fuel containing from 70 to 90 per cent. of moisture, a briquette which can compete with coal, or can make up deficiencies in the fuel supply, is a very serious one. Huge masses of raw material have to be handled and cleansed from foreign matter, and tons of water have to be expelled in order to obtain a limited quantity of valuable fuel. Many processes have been tried and abandoned, as they proved to be too expensive. A few plants in Germany and Holland are working on similar lines with brown coal, but a large portion of the water is expelled mechanically before drying by heat. Much labour and money have been expended in Germany on the development of the peat industry, and nearly all modern methods have originated in that country. Great efforts are being made to establish the manufacture of solid peat briquettes as a permanent commercial industry. In Holland there are many acres of peat bog excavators under cultivation, and supporting from 300 to 350 people per square mile. In some water-filled bog trenches, fisheries are established on a large scale.

BULGARIA'S TEXTILE TRADE.

Bulgaria's imports for the first four months of 1904 amounted to £1,015,000, against £734,000 for a like period in 1903. Inasmuch as the last harvest was a good one, Bulgaria was able to buy more and better goods than would otherwise have been possible. While the textiles purchased in 1900 were worth only £513,000, and those of 1902 £1,100,000—those of 1903 amounted to £1,186,000. Most of these goods go into distribution *viâ* Varna, where a large number of wholesale dealers are doing business with the

ailers from the interior. Most of these men are able, paying cash, and seldom asking for credit. a rule the goods are sold f. o. b. Varna, against h minus discount, or on six months' draft. Of countries participating in this trade, England es the lead, with £445,000, or nearly half of the ire amount. England's success is attributed to the ge number of patterns displayed. Hence, however rd the houses of other lands may labour to oust English dealer, their success, if ever attained, is ly temporary. Another factor in England's favour the presence of Varna wholesale merchants in the iglish markets, particularly at Manchester. These n, familiar with Oriental tastes, are able to aid iglish designers. Oftentimes these people are able arrange for a monopoly of a certain line: indeed ey often suggest the pattern for this purpose. In e case of goods that are easily imitated, however pular, they are soon run out by the almost universal pying. In recent years Italy has shown remarkable ccess along the lines once looked upon as exclusively nglish, the marvellous activity noticeable in Italian dustry, added to cheap labour, being responsible r this success. Italian salesmen are covering every ch of the country: they study the markets, methods selling, &c., and the tastes of the people. The erman trade is far from what it might be. Before can be much better (remarks the German authority om which we quote), travelling salesmen will have emulate English and Italian methods.—*The Textile lercury.*

HE LACE INDUSTRY IN DEVONSHIRE.

The Education Committee of the Devon County ouncil at a late meeting considered the present ondition of the lace industry, and the results of recent inovations.

Classes have been held at Branscombe, Bicton, olyton, Honiton, Sidbury, and Woodbury. It is ow proposed to discontinue the class at Colyton, as e number of pupils is small. Applications for new asses have been received from Beer, Broadclyst, and hudleigh. The Committee are desirous that classes hall be established at these places. But at the present time the head instructress (Miss Ward) is fully ccupied, and the operation of the scheme cannot be xtended, because no assistant teachers are available carry on the work.

Lympstone and Crediton residents have also expressed a desire that classes should be held in their idst. In the former place the Committee consider hat a class for girls might probably be established, ut owing to the difficulty which the head instructress as found in obtaining information the prospect is ncertain. In Crediton little or no lace is made, and he Committee consider that it is undesirable to ntroduce a new industry in a place where so many irls are otherwise engaged. To further encourage the work the Committee have suggested that an attempt should be made to form a central class at Exeter, to be superintended by the head instructress, for the purpose of teaching the girls, who may become qualified to act as assistant teachers. The travelling expenses of these teachers to and from Exeter, it is proposed, should be allowed by the Committee, and a suggestion has been made that the annual sum placed at the disposal of the authority should be increased, in order that such a place of instruction may be established and maintained in the city, and also to enable classes being carried on at Beer and Broadclyst.

ADMIRALTY CHARTS.

The following is the official list of charts issued by the Hydrographic Department of the Admiralty, in May and June last:—

New Charts.—No. 3381—Scotland, west coast; Hebrides, Lewis:—West Loch Roag. 3384—Ireland, south coast:—Queenstown. 3415—Baltic sea; Gulf of Bothnia:—approaches to Räfsö and Biörneborg. 3416—France, west coast:—approach to Brest. 1233—Black sea, plans:—Kustenjeh (Constanta) anchorage; Bender Erekli. 3405—Newfoundland, east coast; Bay of Exploits:—Peter arm. 3390—North American lakes; Lake Huron:—St. Clair river to Goderich (plan:—Goderich harbour). 3424—South America.; Tierra del fuego; Beagle channel:—Cape San Pio to Gable island. 3425—South America; Tierra del fuego; Beagle channel:—Gable island to Lapataia bay. 3426—Philippine islands; plans on the north coast of Mindanao:—Port Misamis; Port Langaran. 1016—Cochin China:—Saigon or Don nai river. 2653—China, north coast:—Peiho or Peking river, Sheet 1, from the entrance to Ko-ku (*Reproduction*). 1663—Japan; plans on the south coast of Yezo:—Fukuyama byochi; Fukushima byochi. 1772—Ireland, east coast; approaches to Wexford harbour; plan added:—Rosslare harbour. 2113—Sicily; plans of anchorages on the west coast; plan added:—Sciacca. 1149—Iceland; plans on the west coast; plans added:—Budir Krossvik. 801—West Indies; Haïti or San Domingo; approaches to Port au Prince; plan added:—Jeremie bay. 3138—Alaska; anchorages in south east; plan added:—Yes bay. 935—Eastern archipelago; harbours and anchorages between Bali and Timor; plan added:—Sermata, west point. 2468—Eastern archipelago; Selabu, west coast; plan added:—Warain road. 2772—Sulu sea; anchorages in Gillolo; plans added:—Ekor and Galela roads; Bobani bay and Pasir Putih anchorage. 3392—Philippine islands; plan added:—Port San Vicente. 1641—China, east coast; harbours and anchorages on the coast of Formosa; plan added:—Taihanroku anchorage. 1280—Korean archipelago; Port Hamilton; plan added:—U-to anchorage. 1999—New Zealand;

Ports Lyttelton and Levy; new plan:—Lyttelton harbour. 2591—New Zealand; sheet xiv.; plan added:—Greymouth harbour. 1490—South Pacific ocean; harbours and anchorages in the Sandwich islands; plan added:—Kaanapali anchorage.

Charts that have received additions or corrections too large to be conveniently inserted by hand:—Nos. 1698—England, south coast:—Dover bay. 1185—England, River Thames:—Sea reach. 2030—Ireland, south-west coast:—Valentia harbour. 3158—Norway:—Nevlunghavn to Torbiornskier. 3159—Norway:—Torbiornskier to Jœlöen. 3160—Norway:—Torbiornskier to Rauö. 1297—Norway:—Lepsö to Ona. 1298—Norway. Approaches to Molde. 2307—Norway; sheet V.:—Smölen to Sves fiord. 2315—Norway; sheet XIII.:—Sörö to North cape. 2316—Norway; sheet XIV.:—North cape to Tana fiord. 2331—Baltic; Gulf of Finland:—Hangö head to Barö sound. 1458—Spain, east coast:—Ports and anchorages. 2740—Iceland and the Færoe islands. 565—Iceland, western portion. 566—Iceland, eastern portion. 3017—North American lakes; Duluth and Superior harbours. 2538—Nova Scotia, Bay of Fundy; Yarmouth to Petit passage. 2488—United States, east coast:—Portland harbour. 2580—West Indies:—Cuba, eastern portion. 2600 — West Indies: — San Domingo to Dominica. 1501—Alaska; Aleutian islands:—Seguam island to Attu island. 1064—Madagascar; plans on the north-east coast. 40—India, west coast:—Karachi harbour. 859—Bay of Bengal; Mutlah river to Elephant point. 934—Eastern archipelago:—Surabaya, &c. 3349—Cochin China:—Approach to Kwang chau wan. 3386—China, east coast:—Long harbour and approaches. 166—China, east coast:—Pagoda anchorage. 372—Japan; Kiusiu, west coast:—Gulf of Kagosima, upper part. 764—New Guinea, &c.; New Hanover; New Ireland and New Britain. 2527 — New Zealand; sheet III.:—Mayor island to Poverty bay. 2411—New Zealand:—Otago harbour. 1913—New Hebrides:—Malekula, northern part. 1579—New Hebrides:—Malekula, southern part.

These charts are issued by Mr. J. D. Potter, 145, Minories.

General Notes.

Technical Optics.—Day courses in Technical Optics, to meet the requirements of those who desire a more thorough training than can be obtained in evening classes, will be established at the Northampton Institute, for the session 1904-5. The chief object will be so to train the students, both theoretically and practically, that they will be in a position on leaving the institution to deal with the numerous scientific and practical problems which all who aspire to take the higher positions in the optical trades must be prepared to solve. The full course as at present contemplated extends over two ye[ars] and consists of lectures, laboratory work, drawi[ng] office work, tutorial classes, and workshop pr[ac]tice. To meet the case of those who cannot dev[ote] their full time to the above training, and w[ho] are already engaged in some optical trade, par[t] courses requiring attendance on two mornings [a] week only, but extending over three years, will [be] given, covering generally the work of the first year [of] the complete course, but omitting certain portions w[ith] which such students will be familiar. The Aitchis[on] Scholarship, presented by Mr. James Aitchison, is [of] the value of £20 per annum, and is tenable for t[wo] years in the day courses of the department of techni[cal] optics at the Northampton Institute. It will [be] awarded in September, 1904. Candidates must [be] not less than 16 years of age on the 1st Octob[er] 1904. The amount of the scholarship (£20) will [be] expended each year in providing for the scholar [an] admission ticket (value £15) to the day courses [in] technical optics at the Institute, and the balance [of] £5 for each year will be paid to the scholar in tw[o] equal instalments, at about the middle and at the en[d] of each session, respectively, provided a satisfacto[ry] report of the attendance and progress of the schol[ar] is presented by the Principal to the Governing Bod[y]. Particulars can be obtained from the Principal, Clerk[enwell], E.C.

Coconuts and Copra.—The figures of expo[rt] distribution of copra and coconut oil for the half-ye[ar] just ended are from the *Times of Ceylon*:—

Jan. 1st to July 4th.	Copra.	Coconut oil.
1904	221,999 cwts.	164,795 cwts.
1903	238,986 ,,	292,281 ,,
1902	138,824 ,,	175,596 ,,
1901	135,900 ,,	155,089 ,,

The United Kingdom, Ceylon's biggest customer, ha[s] so far this year received from 85,711 cwts. of coco[a]nut oil, against 179,977 last year to this date Germany, 7,439 cwts. against 8,035 cwts.; France 503 cwts., against 8,309 cwts.; Belgium, 809 cwts. against 5,735 cwts.; and so on, the decrease being general, except in Holland, where the total this year is 906 cwts. against 674 cwts. last. It will be noted that whereas the falling off in the exports of coconut oil is large, the export of copra, on the other hand has remained without much change in spite of a short crop of nuts. The very bad weather of last year is responsible for the short crop, but the competition of Manilla and of the Philippine Islands is a factor which is growing in importance. Under the influence of American enterprise, and a settled state of existence, the industries of the Philippines are rapidly developing, and the coconut product there must become increasingly formidable as a rival of Ceylon. So far this year the manufacturer in Europe finds it a better bargain to purchase the raw material in preference to the oil, with the result that the millers in Colombo are suffering considerably.

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communications for the Society should be addressed to 'he Secretary, John-street, Adelphi, London, W.C.

Notices.

EXAMINATIONS.

[he results of this year's Examinations ɾade I.) will be published to-morrow ıturday).

[he Grade II. results were issued on the ı July last.

[he Programme for 1905 will be ready ɔut the end of the current month.

roceedings of the Society.

CANTOR LECTURES.

ꞃECENT ADVANCES IN ELECTRO-CHEMISTRY.

By Bertram Blount, F.I.C.

[ecture I.—Delivered March 7th, 1904.

ndustrial electro-chemistry is now passing ough a period of transition. A few years o it was in so infantile a state that all its all doings appeared as feats, at least to its d parents. Now that adolescence has over-.en it a more mature standard should be ɔpted; the actual accomplishment of useful ks must be counted and mere probabilities fulfilment discounted. But adolescence is : maturity, and to discount a probability is : to deny it; there are, at the present, appli-ions of electro-chemistry apparently immi-ıt which may well rank with those that are ɛady established as part of the world's daily rk.

n consequence of the state of change now .ained in applied electro-chemistry it is a ·d matter to give a clear and balanced ꞉ount of its condition and progress. So diligent are investigators, inventors and patentees that the mass of material accumulated and presented to the student of the subject is apt to be a little bewildering; the wood can scarcely be seen for the trees. Methods that are novel and, therefore, attractive may receive more attention than their intrinsic merits deserve, while great and serious undertakings, because of their growth being quiet and free from striking incident, may be little regarded.

In an exhaustive treatise on applied electro-chemistry it is right and necessary that all rational processes which have been or are likely to be turned to useful account should be described and discussed. In a general review of the position and development of industrial electro-chemistry, such as I am trying to give, similar elaboration would be impossible, and if possible, would be futile. A distinction must be drawn between those processes which are of great commercial importance, or illustrate some principle which is likely to be applied in a large and fruitful field, and others which, though interesting and elegant, cannot, from their nature and scope, pretend to more than a limited utility. The construction of a crush hat, no doubt, needs skill in design and care in execution, and if studied in a serious spirit, could hardly fail to interest and inform the mind, but it cannot be considered of cosmical moment, and in a dissertation on clothes would occupy an inferior position to the subject of boots. It is necessary, in all things, to preserve a sense of proportion, and if with this desire I have put on one side many beautiful and ingenious devices, it is in order to give proper position to matters of greater moment. The plain fact is that the number of important electro-chemical industries is comparatively small. The largest is that of copper refining; the production of aluminium is fairly large; of chlorates considerable, and equally, the manufacture of alkali and bleach and of calcium carbide, may be reckoned as of industrial significance. But when computed in money-value, all these things are of moderate dimensions except copper refining; copper refining is of true commercial importance, because the electrolytic method is the only renumerative way, and because, by a happy accident, valuable by-products are obtained by it. The minor applications of electro-chemistry are so numerous and interesting that I suppose many series of Cantor lectures might be profitably delivered on them alone.

The deposition of metals as plating, the recovery of gold from cyanide solutions, the separation of bromine from Stasfurt salts residua, the electrolytic reduction of indigo—all these claim merit and attention, but their discussion would be to that of the staple electro-chemical industries, very much as a dissertation on the cutting of files might rank towards one on the smelting of iron.

At the beginning of our discussion of this subject it is useful to discriminate between industries which are carried on by electro-chemical means solely, and those which are not wholly dependent on electro-chemistry, but can avail themselves of purely chemical methods alternatively. For example, chlorate of potash can be made with as much certainty and of as great purity by chemical as by electrolytic processes; percarbonates on the other hand can, as far as we know, be prepared only by electrolytic means. Products such as carborundum and calcium carbide are, according to our present knowledge, possible only by aid of the electric furnace. Hence for the latter class of substances, competition with all its wholesome power of stimulation must come from within; the former are more fortunate, for they have an alien competitor, probably one which is intelligently struggling for its very existence. It follows that given other advantages equal, electro-chemical processes which have chemical rivals possess a larger chance of reaching perfection than have their less fortunate brethren.

The Winning and Refining of Metals Electrolytically.

Metals are prepared by the electrolysis of their salts either fused or in aqueous solution. They may be refined in similar manner. At present, however, there is scarcely an instance of a metal being refined in a bath of fused salt, though there is no reason why it may not sometimes prove convenient to do this.* On the other hand it happens that the actual extraction or winning of a metal from its oxide or salts is frequently performed in a fused bath, and indeed it may be said that the most noteworthy instances of electrolytic extraction, as distinct from refining, are thus accomplished. There is no causal connection between the result (winning or refining) and the method (electrolysis in solution or of a fused salt), and the relations indicated above may be upset at any time by the invention of new processes. Nevertheless it is interes[ting] to note that on the whole the refining of m[eta]ls industrially is performed in solution, and [the] extraction is carried out in a fused bath.

The greatest of all electrolytic industri[es is] the refining of copper. Probably about 7[0 per] cent. of the world's production is ref[ined] electrolytically, and in the United St[ates] alone about 250,000 tons per year are [thus] refined, yielding 27,000,000 ozs. of silver [and] 346,000 ozs. of gold. The principle on w[hich] refining depends is exceedingly simple. C[rude] copper, containing about 98 per cent. of [the] pure metal, is cast into plates having an [area] of a few square feet; a size about 3 ft. by [...] is about the average, but the precise dim[en]sions are not important provided that [the] plates are convenient for casting and handl[ing]. These plates act as anodes in an electrolyt[e of] copper sulphate made acid with sulphuric a[cid]. They are opposed to cathodes of thin s[heet] copper, and the metal is dissolved from t[he] and deposited on the cathodes in a stat[e of] very approximate purity. How nearly [pure] modern electrolytic copper is, may be gath[ered] from the following analyses:—

	1.	2.	3.	[4.]
	Per cent.	Per cent.	Per cent.	Per c[ent.]
Copper	99·98	99·85	99·92	99·
Arsenic	nil	nil	nil	n
Antimony	nil	trace	trace	n
Lead	0·01	trace	0·01	n
Bismuth	trace	trace	trace	n
Iron	nil	0·01	0·01	0·
Nickel	nil	trace	trace	n
Oxygen	0·01	0·14	0·03	n
	100·00	100·00	99·97	99·

The practical application of the simple i[dea] of dissolving copper from an anode, and de[po]siting it on a cathode, leaving its impuri[ties] behind, either as a sludge from the anode o[r in] solution in the electrolyte, has been effecte[d in] two distinct forms. In the first, or mult[iple] system, the electrodes are connected in para[llel]; in the other method they are arranged [in] series, each electrode acting as both an[ode] and cathode, and in the process of electrol[ysis] being gradually converted from crude into [re]fined copper. This device has the advant[age] of saving a number of connections, and [of] allowing the electrodes to be completely [im]mersed so that the whole of their surfac[e is] available for electrolysis. But to be succes[sful] the rate of corrosion of all the electrodes,

* The refining of aluminium in a fused electrolyte has been proposed; the method is discussed later.

f the whole surface of each electrode must be iirly uniform. To approach this condition, : is usual to employ copper of a purer grade han that necessary for the multiple system, nd even then many partly converted electrodes iave to be scrapped, because in the process of onversion, they fall behind their fellows. Experience has shown that the balance of idvantage is on the side of the multiple ;ystem; the series method, except in certain ;pecial applications, is almost obsolete.

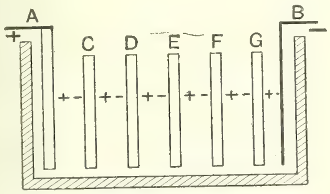
The industry is now so thoroughly established that the arrangement of a works for efining copper electrolytically has ceased to e a question of novel technical interest, and as become a matter of ordinary engineering. The usual conditions for the successful conduct of a manufacture must be fulfilled. There must be easy transport for the crude and the efined copper; the material must be handled mechanically as far as it is practicable; the current must be produced and distributed economically; the turnover must be as rapid as possible, so as to avoid locking up a larger stock of valuable metal than is absolutely requisite for the supply of the tanks; the electrolyte must be circulated so rapidly that its composition is maintained at both cathode and anode, free from excess of copper at the former and of acid at the latter. It is a great advantage to the refinery if it is in direct commercial connection with a mine and a smelting works; it should also be in a position to work up its electrolyte for copper sulphate or crude copper when the limit of impurity has been reached, and to recover gold and silver from its anode sludge. These things are plain matters of manufacturing chemistry, and have no special connection with electrolytic industry as such.

But in order to consolidate one's ideas as to the nature and scope of a large copper refinery, a few details concerning one of the largest of the American works may not be out of place. The Anaconda Works use in all about 3,000 h.-p., a large amount for copper refining, which actually does not need such power, and in theory should need none. The output is about 100 tons a day of 24 hours. There are some 1,200 tanks, covering a ground space of about $2\frac{3}{4}$ acres. The electrodes are arranged on the multiple system, and the handling of each tankload (about four tons) is effected at a single operation and, of course, is done mechanically. The mere work of removing the anode sludge is sufficient to warrant the use of a small electric railway underneath the tanks. The by-products, silver and gold, are not less than $128\frac{1}{2}$ tons, and half a ton per year respectively.

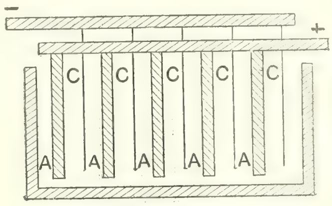
As copper is a high-priced metal, the cost of holding a sufficient stock is an important item in the whole cost of refining. To avoid holding an unnecessarily large stock it is expedient to force the pace in refining by all available means. The cost of power* compared with the total cost being small, energy can be freely expended in order to obtain a high current density and to secure a high output of copper in a given time. The limiting condition in practice is not the cost of the energy but the character of the copper deposited when the current density is high. An ordinary working current density is 10 amperes per square foot, and when this is much exceeded the copper is apt to be deposited in warty masses of doubtful purity and likely to cause short circuiting.

Thus it comes about that every practicable means is used to increase the available current density without impairing the quality of the copper. One of the most obvious and most effective is to make the circulation of the electrolyte so good that there is always an

FIG. 1.



SERIES SYSTEM.

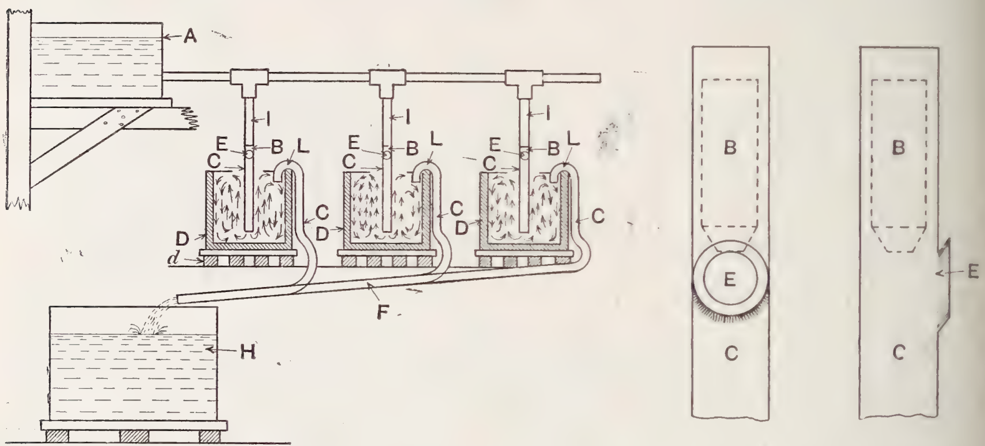


MULTIPLE SYSTEM.

* Even in a well-arranged works there is a good deal of waste in the distribution of the current. Thus Magnus has computed from actual measurements in a large refinery that 20-25 per cent. of the total energy may be consumed in overcoming the resistance of the contacts and connections about the tanks, independently of that absorbed by the leads from the dynamos to the tanks.

ample supply of copper at the cathode; another device is to keep the electrolyte warm; a temperature of about 100° F. is found suitable; by such means a current density of 20 or 25 amperes may be made practicable. A special method of circulating the electrolyte which presents several advantages has been invented by Mr. Dolphin, of Liverpool. In this process a jet, B, of the electrolyte is used in an injector, I, to pull in air and to drive liquid and air together to the bottom of the cell, D, thus agitating its contents; the liquid displaced by that injected continually overflows by the pipe G to the tank H, and is returned to an overhead tank, A, from which it flows again to the injectors. These are shown on a larger scale on the right-hand side of the figure. The effect of this arrangement is so to advantage which is undoubtedly obtained is due to the displacement of bubbles from the cathode or to the burnishing effect of the liquid passing rapidly over the surface of the cathode. The explanation is of interest, but the result is of more direct importance. It is possible by the rotation of the cathode to use a current density as high as 200 amperes per square foot, twenty times that ordinarily employed; in special cases as much as 600 amperes per square foot has been used. The product is so good that seamless tubes of great purity and excellent mechanical strength can be prepared in this way, the metal containing 99·94 per cent. copper, and having a breaking strain in the unannealed state of 24 tons per square inch. At present the process is also in use for making copper sheet.

Fig. 2.



agitate the electrolyte that its content of copper in all parts of the vat is kept constant; there is no local poverty of copper and in consequence a high current density can be used without risk of obtaining irregular deposition. Mr. Dolphin informs me that 25 amperes per square foot can be used in regular manufacturing practice and that the process has the incidental advantage of oxidising the iron salts in the electrolyte, and also causing the precipitation of antimony, thus promoting the removal of two of the impurities most objectionable from the copper refiner's point of view.

A highly ingenious method, and one which has found a considerable practical application, has been devised by Mr. Cowper-Coles. In order to allow of the use of a high current density, he ensures the removal of irregularities from the cathode by rotating it at a high velocity. It is a moot point, whether the

I have hunted with some diligence for other real improvements in copper refining, and the bag has been small. The well-known Elmore process appears to be flourishing in Germany; it is an elegant method, and should have attained success here ten years ago. After suffering from many regrettable causes of delay, it is beginning to take the place which its technical merits deserve. Processes in which the electrolyte is caused to impinge on the cathode have not reached a practical status; processes for making wire direct are in a like condition.

It may be said that except in details of working there is little new to be recorded in the electrolytic refining of copper. The process has settled down on the basis of an established industry, and, unless actually superseded by some method differing from it in principle, is likely to remain a staple manu-

facture. Pure copper will always be wanted, and there is at present no better or cheaper way of getting it.

But the reduction of copper from its ores by electro-chemical means is another matter altogether. At present the electrolytic refiner is wholly dependent on the smelter for his raw material. He is so completely dependent on the smelter that he needs the latter not merely to concentrate the ore into a matte, but to refine the matte to actual metal, crude it is true, but still solid reguline metal. Many attempts have been made from time to time to dispense with the necessity of smelting. Ore has been tried and matte has been tried. All these attempts have failed. There is at present, to the best of my knowledge and belief, no works at which copper is extracted from its ore and is precipitated as pure metal on a large manufacturing scale. Yet there is really no insuperable difficulty about it. At Rio Tinto and elsewhere great quantities of sulphide ores are oxidised naturally or by roasting, the resulting sulphate of copper is precipitated by pig iron, and a crude copper (containing about 65 per cent. of pure copper) is prepared. At such places pure copper could be as readily made electrolytically. To bring the question to a practical issue: sulphide copper ores are roasted, if need be electrically; the ores are leached with sulphuric acid bought for that purpose; the solution is electrolysed between lead plates, and the liquor, partially depleted of copper, is turned back to leach more ore. There will be a small loss of sulphuric acid to be made up; there will be a very slight contamination of the liquor with iron provided the ore is roasted "dead;" there should be no difficulty in recovering practically the whole of the copper. In the old dark days people believed that carbon anodes must be used for such an electrolysis, and pointed out that they would be consumed. It is true that they would be consumed, but their use is not necessary. Lead is the proper material. I look confidently to the time when the extraction of copper from its ores electrolytically will be the standard method, just as electrolytic refining is standard practice now.

Perhaps the most promising effort yet made to realise this belief is due to the Intercolonial Copper Company, at Dorchester, in Canada. The output at present is about one ton a day, which is small compared with the huge quantities handled in modern refineries, and further, it is right to note that the ore is of a specially favourable class for extraction. It is a sulphide ore partly weathered, so that the copper in it is largely present as basic carbonate. It is poor, containing only 2-4 per cent. of copper, but has a siliceous gangue which yields so little soluble matter other than copper, that waste of acid is moderate. The process is carried out by roasting the ore in revolving calciners, leaching out with a 5 per cent. solution of sulphuric acid and electrolysing the solution, using lead anodes. Before and during electrolysis, sulphurous acid, made by burning sulphur, is pumped into the electrolyte, the idea being to prevent the formation of lead peroxide at the anode and incidentally by its oxidation there to make up for any sulphuric acid expended in saturating free lime in the roasted ore. According to Mr. Woolsey M'cA. Johnson, who has described the process, the copper is precipitated by a pressure of 1·5 volts, which is not far above the calculated figure; the current density is six amperes per square foot, and a current efficiency of 90 per cent. is obtained. Quite rightly no endeavour is made to deposit the whole of the copper at a given operation; the content of copper is reduced from 2·5 per cent. to 1 per cent., and the electrolyte is then returned to the leaching vats. The metal obtained is equal in quality to the best brands of copper refined electrolytically.

The electrolytic refining of zinc is not practised, for the good reason that zinc of sufficient purity can be easily obtained by distillation. For most purposes there is no particular need for pure zinc, and the metal as distilled from the ore suffices; if a better grade than can be selected from the brands on the market were needed, it could be obtained cheaply by redistillation, preferably in vacuo. But because the reduction of zinc requires the expenditure of a great deal of energy, and because by the ordinary process this energy has to be conveyed in a very inefficient manner through the walls of small and costly retorts, an electrochemical process in which the energy is more directly and economically applied has on *primâ facie* grounds a good prospect of success. There are two ways in which zinc may be prepared electro-chemically. The first is to heat a charge of zinc oxide and carbon in an electric furnace; the discussion of this may be postponed until the third lecture dealing with electric furnaces. The second way is electrolytic. Here two courses are open, one being to electrolyse an aqueous solution of a zinc salt, the other to use a bath of a fused

zinc salt such as the chloride. Examples of both methods may be given.

(*a*) Reduction of Zinc from Aqueous Solutions.

The investigations of Wylius and Frömm and of Förster and Günther are now some years old, but they may still be regarded as the best guide to the principles of zinc deposition which has yet been published. The great difficulty in depositing zinc from a solution of one of its salts is that the metal is apt to come down in a spongy state, difficult and costly to handle. This condition may be avoided in great measure with zinc sulphate if the solution is fairly strong, containing for example about 10 per cent. of the crystallised salt, and is kept as nearly neutral as possible; if basic, it is much disposed to deposit spongy zinc; many impurities apt to be obtained in leaching an ore, *e.g.*, arsenic and antimony have a like effect. Similar precautions are needed with zinc chloride, the chief difference in its behaviour being due to the fact that it dissolves zinc hydroxide more readily than does zinc sulphate; in consequence of this the solution may be slightly basic without serious risk of obtaining bad deposits. With regard to the metallic impurities it may be said that the most rational way of securing their removal is to electrolyse the solution before it goes into the depositing vats, using a voltage slightly lower than that necessary to reduce zinc.

In spite of the attention that has been given to the study of zinc deposition the practical results have been small. At the present time there is only one method in use, a modified form of the Hoepfner process which has been developed at Brunner and Mond's works. The process is based on the fact that zinc chloride can be prepared by acting on calcium chloride with zinc carbonate, or industrially by using, in place of zinc carbonate, roasted zinc ore and carbonic acid. The zinc chloride is electrolysed and the zinc from the ore and the chlorine from the calcium chloride are recovered in marketable form. The process is at work on a considerable scale, about 1,000 tons of zinc per year being made and the corresponding quantity (about 3,000 tons) of bleaching powder prepared. Needless to say the details of procedure are guarded with some care. This case serves as a good illustration of what is common in electro-chemical processes and indeed in all new industries. It often happens that there is only a single application of what is undoubtedly a useful process, the reason being that the method as it came from the hands of the inventor needed much elaboration, and that those who effected its elaboration desire to reap the fruits of their enterprise; hence they hold their tongues; meanwhile the industry stands still outside their works. The present yearly output of zinc is about half-a-million tons, and of this one five hundredth part is made electrolytically.

(*b*) Reduction of Zinc from its Fused Salts.

This process has been worked out by Swinburne and Ashcroft in a practical form. It consists essentially in the electrolysis of zinc chloride kept melted by the heat generated by the current itself. The process may be more conveniently dealt with in its proper group in the next lecture.

It is doubtful whether treatment of aqueous solutions or of fused zinc chloride would be better in practice. If zinc could be deposited with certainty, free from sponginess, from an aqueous solution, that system has the advantage; if it is found to be impracticable to ensure the deposition of the zinc in a coherent form, boiling-down the solution and electrolysis of fused zinc chloride may be preferable. My own view is that both methods are limited in their utility to certain conditions, and that for the winning of zinc at large, distillation in an electric furnace gives greater promise.

The winning and refining of nickel should be easily accomplished electrolytically. Unfortunately there are found many practical difficulties. The tendency of electro-deposited nickel to curl up from the cathode is an initial trouble. But this concerns merely the act of deposition. Much more serious is the separation of nickel from the metals associated with it in its ores. It so happens that the most abundant nickel ores contain much copper, and the easiest way of procuring the metals is to smelt them to a nickel-copper matte. In the ordinary dry process of refining, satisfactory separation of the two metals is difficult. If the matte is roasted and reduced holus-bolus to metal, a copper-nickel alloy is obtained, which is only marketable for preparing such materials as German silver. The copper and nickel must be separated, and their sepation should be neatly effected electrolytically.

The history of the electrolytic winning of nickel is curious. A few years ago electrolytic nickel was a merchantable article; at the pre-

sent time it is doubtful whether any is being made. There has been a set back in the art. As usual, it is almost impossible to get any authentic information; but reading between the lines one may see clearly enough that the *vera causa* is the greater activity of manufacturers using the older process. Some way back I said that purely electro-chemical industries were at a disadvantage; they needed healthy competition. It is reasonable to suppose that the production of nickel electrolytically will receive a useful stimulus from the present activity of ordinary metallurgical methods.

Mr. Titus Ulke, in a recent paper published in "Electro-Chemical Industry" (Philadelphia), has given an excellent account of the various endeavours to establish nickel extraction by electrolytic means, and in dealing with the history of the subject I cannot do better than avail myself, with due acknowledgment of my obligation, of the material which he has collected and arranged. The first serious attempt seems to have been made by Messrs. Vivian, of Swansea, who used nickel-copper alloy obtained from Sudbury ores. The alloy, containing about 40 per cent. of nickel and 60 per cent. of copper, was cast into anodes and electrolysed in an acid solution of copper sulphate, with a current density of 10 amperes per square foot. The intention was to dissolve both copper and nickel and to deposit copper only, working up nickel sulphate chemically. The difficulty which caused the process to be abandoned was that of completely removing the copper. As the electrolyte became poorer in copper, this metal was no longer deposited in a regular state, but came down in a spongy condition; reduction of the current density did not effectively prevent this, and in consequence the last portions of copper had to be removed by precipitation with sulphuretted hydrogen. This combination of electrolytic and chemical means of separation was too operose and troublesome, and, added to the inconvenience of obtaining a good part of the copper in a spongy and probably impure condition, more than counterbalanced the benefit obtained by taking advantage of the different behaviour of copper and nickel in fairly acid solutions.

Another notable attempt was made at the Balbach Works, at Newark, New Jersey, in 1894. As far as is known, this process was one of refining and not of extraction, nickel anodes containing 94 to 97 per cent. nickel being used. It is supposed that the large production of scrap nickel was the cause of the discontinuance of the process which took place in 1900.

At Cleveland, Ohio, the Canadian Copper Company has tried the separation of copper and nickel, much on the lines described above as being employed by Vivian except that a chloride electrolyte was used.

The process was devised by D. H. Browne, and its description due to Dr. Haber may here be intercalated. It achieved a considerable degree of success, and merits more than a passing notice. A copper nickel matte is roasted to oxide, and the oxide is reduced to a crude metal containing about 54 per cent. of copper, and 43 per cent. of nickel, the remainder being chiefly iron and some residual sulphur. Half the total quantity of metal is cast into anodes, and the other half made into shot. The purpose of the shot is to prepare the electrolyte, which is a mixture of nickel chloride, cuprous chloride, ferrous chloride, and sodium chloride. This electrolyte passes through the electrolytic tanks, where both copper and nickel are dissolved from the anodes and copper alone deposited on the cathodes. These latter are of thin sheet copper, and on them the copper come down in a form not very dense, but sufficiently coherent to be handled and afterwards melted to good merchantable copper. As might be expected any silver in the anodes is dissolved by the chloride electrolyte, and is deposited together with the copper. The proportion of copper to nickel is reduced to the proportion of 1 : 80; the remaining part of the copper cannot be economically separated electrolytically, and is therefore precipitated as sulphide. Iron is thrown out with caustic soda and chlorine, and the purified solution of nickel chloride and sodium chloride is boiled down; the bulk of the sodium chloride is crystallised out, and the solution of nickel chloride run into the nickel depositing vats; here the nickel is separated in great measure, and the weak solution returned to the evaporating apparatus. The electrolytic tanks have nickel cathodes and graphite anodes, the latter being enclosed in clay cylinders so that the chlorine evolved from their surface can be collected. The function of the chlorine is to corrode the nickel-copper shot above mentioned. For this purpose, it is passed into the shot tower together with water, and the sodium chloride deposited during the evaporation of the mixed chloride solution already spoken of. A small make-up of chlorine in

the form of hydrochloric acid is necesssary because of the continual removal of a portion as sodium chloride derived from the caustic soda and sodium sulphide used in precipitating iron and residual copper mentioned above. The nickel obtained by this mode of electrolysis is of exceptionally good quality, containing as much as 99·85 per cent. of nickel, with small percentages of iron and copper. It will be noticed that as far as the latter part of the process is concerned, namely, the electrolysis of nearly pure nickel chloride, there is a considerable analogy with the Hoepfner process for zinc; the step lacking is the production of nickel chloride from oxide, and some cheap chloride such as calcium chloride.

The Frash process tried at Hamilton, Ontario, has, for its object, the dissolution of copper-nickel matte by chlorine, generated in the anode compartment of a cell in which sodium chloride is electrolysed. The difficulty of separating nickel and copper remains precisely as before, and the process is complicated by the difficulty of dissolving matte electrolytically. The Hoepfner process for copper has also been applied to the treatment of nickel-copper mattes and ores, but with dubious success.

Mr. Ulke's own method is designed for the use of the Consolidated Lake Superior Companies at Sault Ste. Marie; and plans and estimates have been prepared for a daily output of 75 tons of copper and 7·5 tons of nickel. The anodes are prepared from Lake Superior and Sudbury — ore smelted so as to contain 88 per cent. of copper and 8·8 per cent. of nickel. The mode of separating the copper and nickel is not given in detail, but when the nickel is obtained as sulphate, it is reduced without actual fusion to metal and refined in a sulphate solution. Electrolytic processes, as publicly described, remind one of an expurgated Lemprière.

My own views about the reduction of nickel may be briefly expressed. Nickel is an uncomfortable kind of metal falling between copper and iron, and comporting itself sometimes like one and sometimes like the other. Copper and nickel go down pretty easily to a matte which can be roasted and reduced cheaply. I think that on analogy with copper it will pay to obtain an alloy of nickel with copper as pure as possible, and to refine this by electrolysis. The electrolyte should be so acid that the anodes are dissolved completely, and that only copper is deposited. The difficulty which Messrs. Vivian experienced should not be insuperable. The solution will contain nickel and impurities. Knowing the bad behaviour of nickel salts on electrolysis I should here abandon electrolysis and recover the nickel chemically. If it were too impure it might be refined electrolytically, which is quite a different matter.

Another metal whose electrolytic preparation or refining is of possible commercial importance is lead. Personally I doubt whether lead will ever rank as a metal for which electrolytic methods are advantageous. Lead is one of those metals which are so easy to reduce and refine that existing processes are perfectly effective and also very cheap. The advantage of electrolytic methods is generally seen in the replacement of difficult or costly chemical or metallurgical operations, and in the case of lead there is no particular difficulty to overcome or heavy cost to be lowered. But putting my own view aside I may perhaps describe what has been done by others who hold that the electrolytic treatment of lead ores is likely to be practicable and profitable.

The Electrical Reduction Company at Niagara Falls have a process for reducing galena. When I visited the works in 1902 the apparatus in use consisted of a number of shallow trays of hard lead piled one on the other and insulated by rubber sheaths. Each tray contains crushed galena, and the whole set of trays is in series, the bottom of each being the anode and the galena resting on the one below being the cathode. The electrolyte is sulphuric acid. In this way the galena is reduced to spongy lead, which is washed free from gangue and roasted to litharge. The sulphur of the galena is evolved as sulphuretted hydrogen, and at present is simply burned. Supposing the process to be found successful, utilisation of the sulphur would be easily done, sulphur or sulphuric acid being produced. The plant is designed for the production of 10 tons of lead daily.

The refining of lead by ordinary dry methods such as the Pattinson and the Parkes process, is carried to such a pitch of perfection that an electrolytic process is hardly likely to produce metal of greater purity. When one remembers that common plumbers' lead contains 99·9 per cent. or more of Pb, one realises that the margin for improvement is not great. Of course it may properly be held that a wet method will be more economical, and taking this into account, Mr. Betts has devised an

interesting process, which has been adopted by the Canadian Smelting Works at Trail, B.C. At these works there are 28 refining tanks each, 7 ft. 2 in. by 2 ft. 6 in. by 3 ft. 6 in. each, and containing 22 pairs of electrodes. The anodes are of lead rich in precious metals, as much as 300 oz. of silver and 3 oz. of gold being present. The electrolyte is lead fluosilicate, which is prepared by running hydrofluoric acid through a tank filled with quartz, and dissolving white lead in the hydrofluorosilicic acid thus produced. The chief merit of lead fluosilicate is its great solubility, and the fact that it can be induced to yield compact deposits of lead. A plain fluosilicate solution will give tree-like growths, but if gelatine is added the lead comes down in a dense form. The *rationale* of this addition is as obscure as many things are in electro-chemistry. The working of this method is rather akin to the refining of silver in a nitric acid solution. The more precious metals remain behind as anode sludge, and the commoner sort will dissolve and will not come down on the cathodes. In practice it is found that the silver remains with the sludge, and that the quantity of baser metals contained in the electrolyte is not excessive. With a cost of power of £6 per horse-power year, the inventor computes the expenditure on this item for refining at 2s. 8d. per ton of lead, and states that the remaining sources of outlay are not greater than those of the Parkes process. I doubt whether a proper comparison can be made in this way; there are sources of expenditure proper to both processes, and these cannot be equated *en bloc*; they must be dealt with separately and in detail.

I have a shrewd suspicion that for some years to come lead with be reduced and refined by methods which are not electrolytic.

Miscellaneous.

MEMORIAL TABLETS.

The London County Council, in continuation of the work which it has taken over from the Society of Arts, has placed a tablet on No. 67, Wimpole-street, the house in which Henry Hallam, the historian, lived from 1819 to 1840. The late Mr. Hutton, in his "Literary Landmarks of London," states that it was here that Hallam wrote his first great work, his "View of the State of Europe during the Middle Ages," but this is obviously incorrect, since the book was published in 1818, and it was only on his return from the Continent, whither he had gone in the summer of that year, that Hallam settled in Wimpole-street. But the "Constitutional History of England from the Accession of Henry VII. to the Death of George II.," published in 1827, and the "Introduction to the Literature of Europe in the Fifteenth, Sixteenth, and Seventeenth Centuries," published in 1837-9, were certainly written there. Hallam was all but heart-broken before the completion of the last of these works by the sudden death of his son, Arthur Henry Hallam, immortalised by Tennyson in "In Memoriam." "I have warnings," wrote the historian at this time, "to gather my sheaves while I can—my advanced age and the reunion in heaven with those who await me," and he wrote little else after completing the book then in preparation, though he lived for another twenty-six years. More sorrows fell to his lot in Wimpole-street, for in 1837 and 1840 his daughter Ellen and his wife died.

Tennyson, in "In Memoriam," thus describes the house as he knew it, when his college friend, the historian's eldest son, lived there :—

> "Dark house, by which once more I stand,
> Here in the long unlovely street.
> Doors, where my heart was used to beat,
> So quickly, waiting for a hand,
>
> . . . . .
>
> A hand that can be clasped no more."

Arthur Hallam was only twenty-two when he died, and his literary remains, which were added to the pathetic memoir written by his father, and privately printed in 1834, showed remarkable promise; but his memory will be preserved by Tennyson's poem rather than by any of his own productions.—*The Daily Graphic.*

THE SUGAR INDUSTRY IN SIAM.

The cultivation of sugar cane in Siam, and the manufacture of sugar, are industries which are capable of being increased greatly with the introduction of better methods in the production of the cane, and modern machinery for the manufacture of the sugar. According to Consul Everard Nash, of Bangkok, the method of cultivation and manufacture which prevails at present is as follows :—Cane is planted during the dry season—December to June—to make cuttings for planting in the beginning of the rainy season—about the end of June. These sections of cane are then planted one or two together, the ground being kept well weeded and thoroughly hoed three or four times during growth. The ripe cane is crushed and the pieces boiled in an iron pot, with the addition of a small quantity of lime, which precipitates the impurities and enables the clear liquid to be drawn off through a pipe into a second pot, where it is again boiled until it becomes a pale yellow colour. This boiling operation is repeated successively in three more pots, when the syrup has reached the consistency and colour of molasses. The molasses is then ladled into small earthen pots, provided with apertures (like flower pots), closed by plugs,

and then allowed to cool over night. When cold the pots are placed on other pots, the plugs removed, and the molasses allowed to drain off, leaving a coarse, yellow sugar. The process of refining consists in pressing down in the pots the coarse sugar thus produced, covering it with prepared earth, and allowing it to stand for a fortnight. Upon removing the earth, a certain part of the sugar is found to be quite white. The layer is then removed, exposing the yellow sugar underneath, when the process is repeated until all the sugar is refined. The molasses which draws into the lower pots in the course of these operations, is reboiled, and subjected to the same processes as before. The quantity of sugar manufactured is far from being sufficient for home consumption, as in 1902, sugar was imported to the value of £182,000, and raw sugar, £3,900. It will be observed from a study of the statistics of Siamese imports, that while the imports of refined sugar are increasing enormously, the unrefined product shows a marked decrease. This can be accounted for in either of two ways. The Siamese are learning to prefer refined sugar, or the production of the unrefined variety is increasing greatly. There are, unfortunately, no statistics of the amount of home-grown cane.

Correspondence.

HAND-WEAVING INDUSTRY OF INDIA.

I shall be obliged by your giving me an opportunity of controverting the statement made in Mr. Coombes' article in your issue of 5th August, 1904, that the foot power or "domestic" loom is altogether unsuited for India.

I introduced these looms with great success in the great penal settlement at Port Blair, all worked by Indian female convicts. They were an enormous improvement on the hand looms in use, and had the following advantages:—They produced a cloth of uniform quality, coarse or fine; the "lengths" produced were constant; the task of each woman could be accurately gauged and fixed according to her strength. All this was very difficult before they were introduced, as with hand looms, the quality of the weaving depends on individual skill, and the cloth produced in a factory varies therefore in quality with each weaver employed. A sharp weaver, too, with a hand loom, can much too easily "fake" the lengths, in a way not easy of detection during the weaving, by not beating up sufficiently. The quality of the cloth is thus spoilt, but the task, fixed in lengths in a given time, is eased.

Our experience in a factory conducted on a scale probably not tried elsewhere—the women weave annually all the clothing required for over 10,000 convicts—was that one woman, on a domestic loom, could weave as much cloth at least, in a given time, as three women on hand looms, and that, too, of an incomparably superior and uniform quality. We found, also, that the women took very readily to the new loom. There were difficulties, of course, on first introduction, but these did not last long.

The chief difficulty in the general introduction of the domestic looms lies in the warp, which has to be good and of uniform quality, such as the Indian hand weaver does not usually produce, but this bad habit of his also spoils the hand-woven cloths he produces. We found special machinery necessary for producing a warp good enough for the domestic loom, but that was quite cheap and can be supplied by the same firms that supply the looms.

Indeed, so favourably was I impressed with the experiment with the domestic looms, that I reported strongly in its favour to the Government of India, and had I remained in India I should have taken up the domestic loom as a machine likely to be of general use in the country, for home industries. But I now perceive that I should have met with "expert" opposition from a quarter where I should not have looked for it. I cannot help feeling disappointed that in his zeal for the hand loom, Mr. Coombes should have paid insufficient attention to the merits of the foot loom, which is a very much better machine. If such natural difficulties as are in the way of its general introduction, were resolutely faced, it would give the native weaver a chance he can never otherwise get of competing with the power-loom woven cloths. R. TEMPLE.

The Nash, Worcester.
August 6th, 1904.

General Notes.

ASSISTANT TEACHERS IN FRENCH LYCÉES.—The Board of Education have received from the French Government a notification of their intention to attach as temporary assistants to certain Lycées a number of young English secondary schoolmasters, or intending schoolmasters, who have undergone an approved course of training and hold some recognised diploma for secondary teachers. These assistants will not take any share in the regular work of the school, but will conduct small conversation groups under the direction of the Proviseur. Two hours' work a day will be expected of them. The rest of their time will be at the disposal of the assistants, who will thus be able to pursue their own studies. The assistants will receive no remuneration, but will be be boarded and lodged at the institutions to which they are attached. Candidates for such posts should forward their applications to the Director of Special Inquiries and Reports, St. Stephen's House, Cannon-row, S.W., enclosing testimonials as to character, capacity, and teaching experience, and a medical certificate of health. It will also be necessary for each candidate to have a personal interview with the Director at his office, and should any candidate have any special desire as to date of interview, it would be well to indicate it when forwarding the application.

Journal of the Society of Arts.

No. 2,700. Vol. LII.

FRIDAY, AUGUST 19, 1904.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

TEN-VOLUME INDEX TO "JOURNAL."

The new Index to the *Journal* of the Society of Arts for volumes xli. to l. (1892-1902), is now ready, and can be obtained by members on application to the Secretary, John-street, Adelphi.

The price of the Index to non-members is half-a-crown.

Proceedings of the Society.

CANTOR LECTURES.

RECENT ADVANCES IN ELECTRO-CHEMISTRY.

By Bertram Blount, F.I.C.

Lecture II.—Delivered March 14th, 1904.

Preparation of Metals from Fused Electrolytes.

Aluminium.—Aluminium affords a typical instance of a metal which is prepared exclusively by electrolysis in a fused bath. The number of attempts which have been made to prepare it in some other way would literally fill a book—they have indeed filled several. The whole history is highly instructive. Because aluminium needs for its reduction a great expenditure of energy it cannot be reduced from its oxide at any ordinary metallurgical temperature, and at the higher temperature of the electric furnace it unites with part of the carbon necessary for its reduction. Aluminium carbide, though an interesting body, is of no commercial value at present; hence electric furnace methods are not directly practicable. It is possible enough that eventually they may be applied for producing aluminium. Let us suppose alumina reduced by carbon at a very high temperature in the electric furnace, and aluminium carbide obtained. If this were fused with alumina the product should be aluminium, the reaction proceeding very much as that indicated by Moissan for chromium. Unhappily for this idea, aluminium at this great temperature would probably volatilise, and the condensation and collection of the distilled metal might prove difficult.

Dismissing these speculations, let us examine the condition of the art. There is a single process for making aluminium which consists in electrolysing an aluminium salt or oxide between a carbon anode and an aluminium cathode, the bath being kept hot by the current itself. The process is named according to patents and patriotism, Hall, Héroult or Minet, but in essence it is the same.

Before discussing the electrolysis of aluminium salts, it is necessary to speak of alumina. This is the raw material of aluminium, and on its abundance and purity the cheapness and quality of the metal depend. The process used by the British Aluminium Company at Larne, may be taken as a good example of the care and skill which have to be bestowed on the manufacture of this material.

At Larne, the original intention was to use an Irish bauxite, which contains a high percentage of alumina, and is fairly free from iron. But in practice it was found better to use bauxite imported from France. The French mineral contains 12 to 15 per cent. of ferric oxide, but yields a better return of alumina than the Irish ore, the chief reason being that in the process of extraction the latter, with its considerable proportion of silica, formed an insoluble double silicate of alumina and soda, whereby not only is alumina lost, but soda is wasted. This unexpected result is one of those troubles, common in all new undertakings, which are extremely difficult to guard against; something might have been done by small scale working controlled by analyses of the ingoing and outcoming stuff, but even if that plan were adopted, it is by no means certain that the reactions would proceed just as they do on a large scale. Faraday once said that when he went into a works, all his chemistry dropped out at his finger-ends; probably Faraday's great modesty misled him, but for lesser people his remark is exact. It is the hardest thing to translate well-known and definite chemical reactions into manufacturing practice.

At Larne, the French bauxite is crushed in a stone breaker, put through a "Tiger" mill and an Askham's separator, and roasted in a revolving calciner heated by a coal-fed grate; it passes from this into a rotatory cooler fitted with blades. The roasted ore is extracted with caustic soda in kiers holding about 1,500 gallons of liquor apiece and capable of treating 1 ton of ore. The alkaline extract is diluted and filtered. The sludge, which retains a certain amount of soda, is run on to "slob" grounds, and after settling, the supernatant liquor is pumped back. It contains some soda which would otherwise be lost; the recovery may well be due to carbonation while the sludge liquor is exposed to the air. The filtered liquor is ready for precipitation, which is done by the Bayer process. Formerly alumina was made from sodium aluminate by throwing it down with carbonic acid; more lately it has been found possible to take advantage of the fact that sodium aluminate is a highly unstable compound, and its decomposition can be determined by adding to its solution a little preformed alumina. This is carried out in practice by not completely emptying the precipitating tank, so that the fresh liquor from the extractors is brought at once into contact with alumina from the previous precipitation. As only about one-fifth of the total quantity of alumina present is precipitated by the Bayer process, there is a very large volume of aluminate solution continually going round and round. Seeing that this has to be concentrated to make it strong enough to extract a fresh quantity of bauxite and diluted again for filrering and precipitating, it is evident that large volumes of water have to be evaporated. The precipitated alumina is washed, dried, and calcined. It is almost chemically pure.

The fact that alumina contains only about half its weight of aluminium, and that to produce pure metal pure alumina must be used, makes the question of the supply of cheap and good alumina of vital importance to the maker of aluminium. From the description given above it is clear that the present process must be worked with much skill and care, and at the best cannot fail to be costly. It is probably not far from the truth to say that the cost of alumina is about one-third the total manufacturing cost of aluminium produced from it. Any mode of cheapening its production is therefore of considerable moment.

In the early days of electrolytic manufacture of aluminium, salts such as the chloride or fluoride, either of aluminium alone or of aluminium and an alkali or alkaline earth metal, were electrolysed in vessels heated from without. It was soon found that no practicable material was capable of withstanding the heat from without and the corrosion from within, due to the electrolyte or its products. Hence in a short time all processes which succeeded in attaining a working footing were made dependent on the heating effect of the current itself. Two simple forms due to Minet illustrate the principle clearly.

FIG. 3.

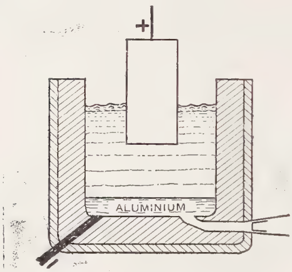
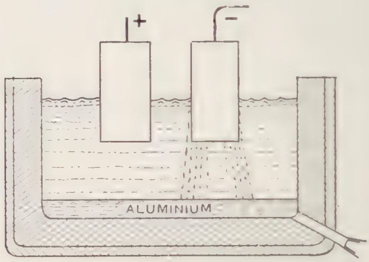


FIG. 4.



In Fig. 3, fused aluminium itself forms the cathode and the anode is of carbon. In Fig. 4 the reduced aluminium is not connected electrically with either pole, but in the bath are two carbon electrodes between which the current flows with sufficient intensity to keep the electrolyte fused.

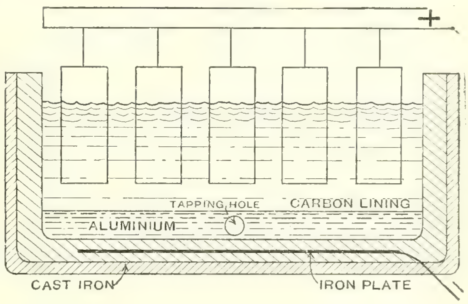
In the original Hall apparatus external heating was adopted, but it was soon given up and the present apparatus is certainly one in which the heating is internal. The early Héroult apparatus was devised to produce aluminium alloys. The history of its development as told by Héroult himself is informative and may be quoted. Héroult first tried to obtain aluminium by the electrolysis of aqueous solutions; he erred in this, having paid insufficient attention to thermo-chemical data, but quickly realising

the impracticability of such a method passed on to the use of fused salts. At the date of his first experiments the apparatus available was far from perfect. Good carbon electrodes could scarcely be obtained, and when a carbon crucible was wanted it had to be laboriously ground out of retort carbon. Héroult's notable discovery that alumina could be electrolysed in a bath of haloid salts occurred curiously. He found that the anode was attacked in an electrolyte of the double chloride of sodium and aluminium and came to the conclusion that an oxide must be present; this oxide proved to be alumina derived from the decomposition of the aluminium chloride by moisture. It was but a short step from this to add alumina deliberately to the bath and to electrolyse it with corresponding destruction of the carbon anode. But at the time (1886-1887) the outlook for aluminium as a commercial metal was not particularly bright. No less an authority than Pechiney of Salindres told Héroult that aluminium might find a use for such *articles de luxe* as opera glasses; for serious purposes it hardly counted. Now it is an economic law that the more costly an *article de luxe*, the more freely it sells; hence attempts to reduce the price of aluminium could only lead to the impoverishment of everyone concerned, except the buyer, and he hardly counts. But Pechiney held that aluminium bronze was a useful alloy with large mechanical possibilities. All acquainted with the matter will agree with this belief, and it has been a matter of wonder to me that even now when aluminium is cheaper than could be guessed 20 years ago, so little of this excellent alloy is made. It was in consequence of this depreciation of aluminium and this extolling of its copper alloy that the first Héroult furnace for the production of aluminium bronze was patented.

The whole of this description by Héroult of the line of thought and work which he followed is very interesting and curious, and it is worth while to pursue the matter a little further and hear his views on the process of electrolysis which occurs in the modern aluminium furnace. Although it is generally believed that in the electrolysis of a typical aluminium bath consisting of cryolite in which alumina is dissolved, it is the alumina that is electrolysed, an alternative view is possible. If pure cryolite is electrolysed, aluminium is obtained but not fluorine; the electrolyte is found to contain acid sodium fluoride according to Héroult. (The source of the hydrogen for NaFHF is obscure.) By using a higher temperature no aluminium is obtained, but sodium comes off freely. On these grounds Héroult concludes that the primary course of electrolysis is the separation of sodium which reduces aluminium from its fluoride; the necessary supply of aluminium fluoride is regenerated by the joint action of fluorine (or of fused compounds containing more than their normal proportion of fluorine) on alumina in the presence of carbon, precisely as aluminium chloride is prepared by acting with chlorine on a heated mixture of alumina and carbon.

The weak point in this argument is that we have to postulate the existence of a sort of perfluoride of sodium, or rather a fluoride corresponding with the ordinary acid fluoride NaFHF, but containing no hydrogen and having the constitution NaFFF. At

FIG. 5.



present there is no evidence of the existence of such a body, and pending its being laid on the table, I, for one, prefer to regard the reaction in the Héroult bath as an electrolytic decomposition of alumina dissolved in cryolite.

From a practical point of view, the matter is of minor importance. Into a bath of mixed fluorides of sodium and aluminium, provided with a carbon anode, alumina can be fed, and can be electrolytically decomposed with the production of aluminium and carbon monoxide and without the liberation of fluorine.

A comparatively shallow iron box is lined with carbon blocks; old anodes fitted and cemented together serve very well. In the floor of the box is an iron plate by which the current is conveyed, so that the carbon floor forms a cathode, and there is no particular temptation for the current to wander about in the lining at large. Deposition of aluminium in casual places is thus avoided to a great

extent. The size of the box and the position of the electrodes are so adjusted that the cell when working really consists of a pool of fused cryolite and alumina standing over a pool of fused aluminium, the walls containing them remaining fairly cool. The temperature of the whole arrangement is very moderate, about 800° C., and the process goes on quite quietly without fireworks. The anodes dip down through a crust of half-congealed electrolyte and through this crust alumina is fed in from time to time and aluminium tapped off. There is a total absence of fume, and the fear which has been expressed that aluminium works might give forth vast volumes of fluorine sufficient to blast a neighbourhood appear to rest on the unscientific use of the imagination.

It may be taken that the world's supply of aluminium is made in furnaces of this class; that in all cases the material reduced is alumina; there may be various fancy electrolytes, but I doubt it; fluorides seem most suitable.

On account of the great cost of producing pure alumina from bauxite or any other aluminous material, a considerable advantage would be reaped by the aluminium industry if bauxite could be refined cheaply, or if crude aluminium could be produced from it and the impure metal then refined. At present it is difficult to imagine a process better adapted for refining the ore than the costly and laborious system of extraction which has been described. It may be more practicable to refine the metal. If roasted bauxite were fed into an ordinary fluoride bath, probably a good deal of the silica, titanic acid, and iron oxide would dissolve as well as the alumina. Of the part thus dissolved the iron would appear at the cathode and some of the silicon and titanium. The alloy of aluminium with iron, together with a little silicon and titanium could be used as a deoxidising dose for steel as satisfactorily as pure aluminium, and seeing that the greater part of the world's production of aluminium goes for such purposes, the impure material would serve as well as the 90 per cent. grade of aluminium at present used. For the production of pure aluminium from the crude metal a process of electrolytic refining must be employed entirely comparable with the refining of copper, auriferous silver, and like metals. The crude metal would be made the anode in a bath of fluoride, and dissolved and precipitated on a cathode of aluminium. The less soluble or less electropositive impurities would remain as an anode sludge and the more electropositive impurities would remain in solution in the bath. A process of this kind has been patented by the Pittsburg Reduction Company, which controls the output of aluminium in the United States, and unquestionably the method presents considerable possibilities.

A little table, taken from that indefatigable publication "Mineral Industry," may not be out of place:—

World's Production.

1897	3,394,448	kilos.
1898	4,033,705	,,
1899	6,570,389	,,
1900	7,338,173	,,
1901	7,571,211	,,
U.S.A.		
1901	3,311,213	,,

It will be seen that the total output is quite moderate, being about 7,500 tons per year. When it is remembered that the production of zinc is about half-a-million tons, it will be realised that there is still some field for the lighter metal.

I cannot refrain from appending to the table a note which follows it. "*United States Duty.* The duty on aluminium imported into the United States is 8 cents per lb. on ingot metal, and 13 cents per lb. on sheet and manufactured metal." But I will most steadfastly refrain from any comment on this enlightening statement.

Sodium.—Innumerable attempts have been made to produce sodium cheaply. Not very long ago—twenty years or so—it was a kind of chemical curiosity costing half-a-crown an ounce. A drop in price to 10s. a lb. was revolutionary. Now it costs less than edible butter. But the sad part of the business is that sodium, being now within everyone's reach, is no longer in eager demand—a situation apt to recur in other affairs. Formerly the great incentive to make sodium was to obtain a means of reducing aluminium. At the present time aluminium is obtained exclusively by direct electrolysis, and the chemical reduction of its salts by sodium has ceased to have any practical interest. This limitation of the outlet for sodium is to be regretted, as it has tended for some years past to discourage serious attempts to cheapen the production. A good process exists, and there has been no pressing endeavour to improve it. It is conceivable that sodium might be used as a source of power in a primary cell, in which case for such purposes as electri-

cal motor carriages it would prove a fairly cheap and compact fuel. The calorific value of its oxidation compared with that of petrol is only about one-fourth that of petrol, but, on the other hand, an electric motor will give in mechanical power about four times as good a yield as a petrol motor on the energy supplied. Hence, weight for weight, sodium and petrol are pretty nearly on a par. The invention of a primary cell using sodium affords a pretty problem which I commend to the ingenious. Evidently it must be lighter than an ordinary accumulator per unit of energy if it is to be of practical value for motor work.

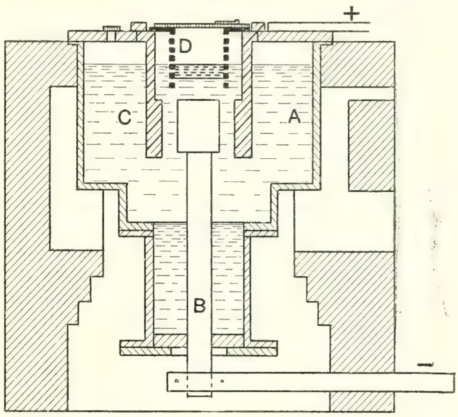
But pending the advent of some such large output for sodium, existing sources of demand must suffice. I understand that the use of sodium for such purposes as the manufacture of cyanide and of sodium peroxide is growing steadily, and seems even now to have reached a point where the quantity of sodium consumed is large enough to warrant a considerable amount of effort to capture the market by a product materially cheaper than can now be made. It follows that there is an opening for a new sodium process.

At the present time, as far as I know, the Castner process is the only method at work on a manufacturing footing.* Essentially it consists in the electrolysis of caustic soda kept at a temperature but slightly above its fusing point. Castner's explanation of the necessity of this is worth recalling. He states that even at its melting point caustic soda dissolves both sodium and oxygen, and that this dissolution becomes rapidly greater with rise of temperature, until a point is reached at which substantially no permanent separation of the products of electrolysis can be secured.† The practical deduction is that the temperature must be kept as low as possible, and must be maintained so nearly constant that there is no risk of the caustic soda solidifying; moreover, means should be taken to remove the products of electrolysis from the electrolyte with all convenient speed. To meet these needs, the apparatus shown diagrammatically in Fig. 6 was devised:—

An iron vessel A contains the fused caustic soda. The cathode B is an iron rod passing through a tubular extension at the bottom of the vessel A. It is surrounded by the iron ring C, which acts as anode. Hanging over the top of the cathode is a ring of iron gauze, D, and in this the sodium collects as it rises from the cathode. It does not readily wet the iron gauze, and so is confined within the ring; by this means it is prevented from straying to the anode and there being oxidised, while hydrogen which accompanies it readily escapes. A similar advantage is taken of the difficulty with which sodium wets iron in the removal of sodium from the bath; it is dipped out with a perforated iron spoon; caustic soda runs back into the cell and the metal being unable to pass through the perforations, remains in the spoon and can be poured off into another vessel.

The Castner process is in use on a large scale at Weston Point and at Niagara Falls. At the latter place it is stated that 1,000 h.p.

FIG. 6.



is used and that the output is 6,250 lbs. per day, corresponding with about 900 tons per year of 365 days.

The Becker process resembles the Castner in some respects. The electrolyte is a mixture of caustic soda and sodium carbonate which is kept fused by heat provided by the current. The apparatus and its electrodes are of iron or an alloy of nickel and iron; the sodium from the cathode is collected by a cone hanging in the bath and connected through a resistance to the cathode, this device being adopted to hinder oxidation of the cone and the metal which it contains. The bath is only semi-fluid except between the electrodes, where it has a temperature of about 550°C. Cells taking 1,250 amperes apiece have been used and others of larger size requiring 5,000 amperes are to be built. No information is yet available of the actual working of this process.

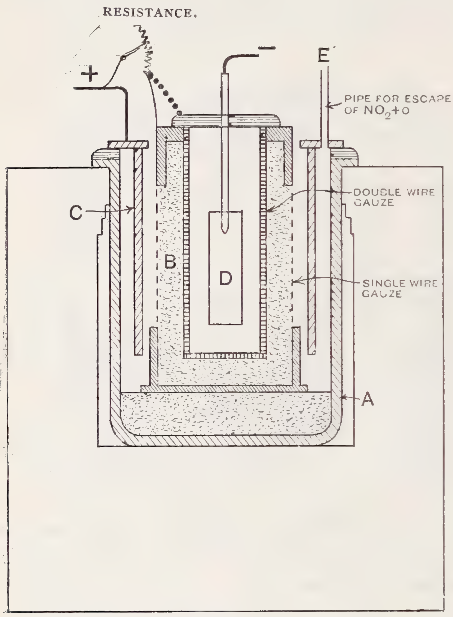
Good and well devised as is the Castner

* The Becker process is stated to be at work, but on what scale is not publicly known.

† A similar result occurs with other fused electrolytes, *e.g.*, lead chloride.

process it has the drawback that the raw material needed is caustic soda, which is comparatively high in price and yields no saleable product except sodium. Sodium chloride evidently would be a better material if its electrolysis were practicable, because it is not only cheap but also would yield chlorine as well as sodium. The difficulties in using sodium chloride and the endeavours which have been made to overcome them will be dealt with below. Another salt which has considerable merits as a source of sodium is the nitrate. Sodium nitrate is cheap (about £9 a ton), and from it can be obtained sodium and the elements of nitric acid, viz., nitrogen

FIG. 7.



peroxide and oxygen. If electrolysed in an undivided cell, the sodium, at the moment of its liberation, would be oxidised by the nitrate, and could not be obtained as metal. Therefore a cell must be used in which sodium nitrate is on the anode side of a porous partition and on the cathode side some other sodium compound in which metallic sodium can exist without acting upon it. Sodium chloride fulfils this condition, but its melting point is too high. The most suitable substance is caustic soda, which has a melting point of 320° C, very close to that of sodium nitrate, 310° C. The caustic soda only serves as a means of transmission for sodium ions and is not consumed.

These ideas have been developed into a process by Darling, whose plant has been erected at Messrs. Harrison's works at Philadelphia. The cell is shown in section in Fig. 7. It consists of an iron pot A, within which is a porous cell B of special construction. The anode C and the cathode D are iron cylinders, and are insulated from the outer pot and the porous vessel. The gases liberated at the anode are led off by the pipe E. The porous septum is made of well burnt magnesia mixed with Portland cement. These materials are enclosed in a cage, the top and bottom of which are of iron plate and the sides of iron gauze or netting. The porous pot has a solid foot and rests on a layer of Portland cement at the bottom of the containing vessel. In order to protect this metal envelope, a small part (about 5 per cent.) of the current is shunted from the anode to one or both walls of the envelope.

The plant at Philadelphia consists of 12 cells about two feet in diameter and about three feet in height. Each will take 400 amperes and requires a pressure of 15 volts. At the start the electrolyte, viz., sodium nitrate in the anode compartment and caustic soda in the cathode division, is fused by heating from without; afterwards the fusion is maintained by the heating effect of the current. Sodium is baled out of the inner cell from time to time, and the gases from the anode division are passed into large stoneware Woulffe's bottles which contain water. The reaction said to occur is :—

$$(1).\ 3NO_2 + H_2O = 2HNO_3 + NO.$$
$$(2).\ NO + O = NO_2.$$

the NO_2 thus regenerated serving to produce a further quantity of nitric acid. Whether this process will work smoothly in practice, and yield concentrated acid is not certain.

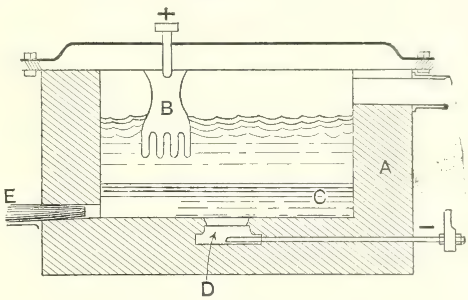
The electrolysis of sodium chloride for the production of sodium and chlorine would be, if practicable, the simplest and most remunerative method for preparing the metal. The high fusing point of sodium chloride, and the fact that the fused salt attacks most materials suitable for vessels in which it can be fused, are difficulties of considerable magnitude. Innumerable attempts have been made to devise a working process. The electrolysis of sodium chloride fused by external heat, for the direct production of sodium and chlorine, has consistently failed. Processes in which sodium itself is not separated, but an alloy of sodium with some metal, such as lead, is prepared, have had a greater measure of success.

An early example of this class of process is that devised by Vautin, who electrolysed fused salt between a carbon anode and a lead cathode; sodium was liberated and dissolved in the lead, and the alloy of lead and sodium was run off and treated with water to produce caustic soda. The method failed for several reasons, prominent among which was the difficulty of constructing a cell which could be heated externally, and would resist the action of fused salt. The Hulin process is similar in principle, but besides the main anode of carbon there is a secondary anode of lead, the object being to provide the sodium as it is produced with the necessary amount of solvent metal and prevent the formation on the surface of the cathode of a crust of alloy unduly rich in sodium and not sufficiently mobile. This process was tried on a manufacturing scale at Gavet, in France, but the company exploiting it is now defunct, and the process has been given up. Another process employing lead to collect the sodium is in use by the Acker Company, at Niagara Falls, and resembles the Vautin process with the important difference that the heating is internal by means of the current. Although applied to the manufacture of caustic soda the Acker process may be conveniently considered here, as the process of electrolysis is directed to the production of a lead sodium alloy, and the preparation of soda by acting on this with water is a purely chemical matter. It is stated that 45 cells each taking 8,000 amperes at 7 volts are in use and have a current efficiency of 93 per cent. and an energy efficiency of 55 per cent. The daily output is 264 kilos. of caustic soda, and the corresponding quantity (about 610 kilos.) of chloride of lime.

Another sodium process must be briefly referred to, viz., one recently invented by Ashcroft. In this the heating is internal by the current, the electrolyte is sodium chloride, and the sodium is collected in lead. Circulation of the lead sodium alloy is secured by an electro-magnet placed beneath the cell. A point of interest is that the lead-sodium alloy is transferred from the cell in which it is produced and made the anode in a second cell in which the electrolyte is fused caustic soda; sodium is thus transferred from the lead alloy to an iron cathode and can be collected as metal.

Zinc.—The production of zinc by the electrolysis of a fused electrolyte may be appropriately dealt with here. The manufacture of zinc by the electrolysis of its aqueous solutions was mentioned during last lecture, and it was then indicated that a fusion process had a good deal to recommend it. The chief advantages of using a fused electrolyte are that difficulties with spongy zinc disappear and that a high current density may be used. The apparatus used by Swinburne and Ashcroft was devised for the Phœnix process but is capable of general application. In the Phœnix process zinc chloride is obtained by the bessemerising of complex lead and zinc sulphide ores with chlorine in a converter and extraction of the mass of chlorides resulting. The solution of zinc chloride is boiled down and the salt is fused and then electrolysed. Because zinc chloride in the process of boiling down suffers hydrolysis a preliminary treatment is necessary; the fused

Fig. 8.



salt is electrolysed in a separate cell at a pressure which will decompose the residual water and but little of the zinc chloride; incidentally the anodes are oxidised and consumed. This is of small importance, as cheap carbons are used for this stage of the process. The purified zinc chloride is electrolysed in another vessel, which is merely a tank built of firebricks and having carbon rods as anodes and a bath of fused sinc as cathode. The bath is heated by the passage of the current; in consequence the walls may be thick and are permanent. The arrangement is shown in the figure. A is the containing vessel, B is one of the carbon anodes dipping into a bath of fused zinc chloride; C is a pool of fuzed zinc, serving as a cathode and connected with the source of current by the steel shoe D; and E is the tapping hob through which the zinc is drawn off.

Alkali and Bleach.

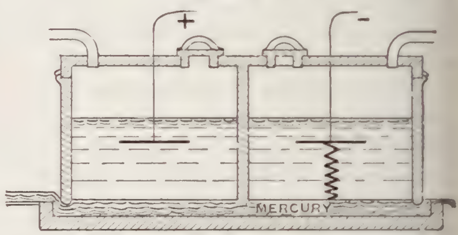
The processes at present in successful use fall almost wholly into two classes. In one an intermediate electrode of mercury

is used in an aqueous solution of common salt; in the other salt is fused and electrolysed with a cathode of melted lead. A typical example of the latter is the Ackers process, already mentioned under the head "Sodium." The latter is exemplified by the Castner-Kellner process in use at Weston Point, near Runcorn. As is well known, it consists of a cell divided by a non-porous diaphragm, having a layer of mercury at the bottom into which the diaphragm dips. One compartment is filled with a solution of salt; in this is a carbon anode; the layer of mercury at the bottom of the cell serves as a cathode; in the other compartment is water, or (in the process of working the cell) a solution of caustic soda. In this compartment the mercury which can flow from the neighbouring compartment acts as an anode; the ultimate cathode is of iron. The whole object of the mercury is to transfer sodium from the salt compartment to the caustic compartment, so that a solution of caustic soda may be obtained unmixed with salt. This avoids the great difficulty of the older forms of cell, such as the Greenwood and Richardson and Holland, in which either a porous diaphragm was necessary, or in which caustic soda was obtained not as a pure solution, but mixed with a great quantity of salt. There have been many adaptations of this principle, with corresponding modifications of apparatus.

In this apparatus the mercury, instead of being caused to flow backwards and forwards from one compartment to the other, as in the Castner-Kellner cell used at Weston Point, is circulated continously through the two compartments. A neat device for preventing the fouling of the mercury consists in sending a small part of the current direct to the mercury in the right-hand compartment, instead of through the electrolyte. The *raison d'être* of this is the tendency for a certain amount of local action to take place in the anode compartment, whereby the amount of sodium disdissolved there in the mercury is slightly less than is equivalent to the chlorine liberated at the anode. Consequently, in the other compartment there is rather less sodium than will suffice for oxygen equivalent to the hydrogen evolved at the ultimate cathode; hence oxidation of the mercury in the right-hand compartment is apt to occur. This inconvenience is overcome by diminishing this quantity of oxygen, that is to say, by causing the current flowing from the mercury to the iron cathode to be a little smaller than that flowing from the anode to the mercury in the other compartment. The arrangement is represented diagrammatically in the figure by a slender wire of high resistance connecting the mercury and the iron cathode; needless to say, it is not necessary that the connection should be inside the cell. The arrangement as shown is self-explanatory.

Other types of cells in which a porous diaphragm is used, instead of mercury, or which have no diaphragm, may be mentioned. The Le Sueur cell is an example of the first, and the Bell cell of the second. Their points of interest depend on their details of construction rather than on their illustration of any fresh principle. The Hargreaves-Bird process, on the other hand, is in many ways original. The cell has a diaphragm and cathode all in one as it were, copper gauze being closely applied to an asbestos sheet, and the joint structure enclosing the compartment in which carbon anodes are placed. On the outer side

FIG. 9.



of the diaphragm and cathode is a shallow chamber into which carbonic acid and steam are passed. The object of this arrangement is to secure the cathode product unmixed with brine. In the process, as worked at Middlewich, carbonate of soda is prepared; but it should be possible to manufacture caustic soda by omitting the carbonic acid from the cathode chamber, and using steam alone.

Potassium Chlorate and Hypochlorites.—On *a priori* grounds it should be a simple matter to prepare chlorates and hypochlorites by the electrolysis of a chloride solution. When the chloride of an alkali metal is electrolysed, chlorine appears at the anode and caustic soda, together with hydrogen, at the cathode. If the caustic alkali and the chlorine are mixed, the product will be a hypochlorite if the temperature is low, or a chlorate if the liquid is at or near its boiling point. This principle has been applied in a variety of ways with a considerable amount of success. The preparation of a hypochlorite is relatively easy when it can be used on the spot

where it is prepared, and after use the spent liquor in which the chlorine has reverted to the form of chloride can be returned to the electrolysing cells, and reconverted into hypochlorite. This procedure is well suited for use at a works where paper pulp or textile materials are bleached. As on the continued electrolysis of a chloride, a stage is soon reached at which the products themselves are electrolysed and destroyed, it is necessary to stop the process at a point where the concentration of the products is still low. For example, in the preparation of bleaching fluids about 10 grammes per litre of available chlorine is an ordinary working limit.* As this is sufficient for ordinary bleaching purposes there is no disadvantage in this restriction if the liquid is to be used on the works; if, on the other hand, a bleaching liquid is to be prepared for outside use, it must be made not directly but by the action of chlorine on a solution of caustic soda of appropriate strength; of course the caustic soda and chlorine may be prepared in a diaphragm cell.

The manufacture of chlorate of potash is understood to be a flourishing industry. I consider that this must be true, because information concerning details of procedure is extraordinarily scarce. It is fair to conclude that no great novelty has been devised, but that the differences between various forms of plant rest in small matters of arrangement and construction which, though involving nothing new, startling or discussable, largely influence smooth working on a practical scale. It may be taken that a typical chlorate cell will be one containing a solution of sodium or potassium chloride kept near boiling point and electrolysed between platinum or graphitised carbon electrodes not separated by a diaphragm; the obvious alternative of working with a diaphragm cell and passing the chlorine into the caustic soda in an outside vessel is evidently not an electrolytic process for chlorate. As in the case of hypochlorites, the concentration of the product, chlorate, must be kept low to prevent its reduction at the cathode. Therefore, it must be removed by the usual processes of concentration and crystallisation employed in the chemical manufacture of chlorate. The device proposed by Kellner to hinder the cathodic reduction of the chlorate may be mentioned. It consists in adding to the chloride solution a small quantity of lime or magnesia. This dissolves sparingly and itself carries no current worth naming. But at the anode it forms calcium chlorate and chloride, and the latter accumulates in sufficient quantity to carry an appreciable portion of the current. Hence calcium hydroxide is precipitated at the cathode and forms a kind of diaphragm hindering the reduction of the chlorate.

* I am informed that the well-known firm of Schuckert and Co., of Nuremberg, are producing bleaching liquor containing as much as 20 grammes of chlorine per litre.

Although one of the minor applications, and not strictly within the bounds of this series of lectures, yet the process of electro-zincing or cold galvanising is of sufficient importance to warrant mention. One of the most successful methods of electro-zincing has been worked out by Mr. Cowper Coles, whose apparatus has proved to be industrially valuable, and is in use in various works. In this process the electrolyte is a solution of zinc sulphate, containing 35 oz. of the crystallised salt per gallon, slightly acidulated with sulphuric acid. The anodes are of lead, and the strength of the electrolyte is maintained by adding zinc dust to the bath. This is found preferable to using zinc anodes which dissolve irregularly. At the beginning of the operation a high current density is used to "flash" the surface with zinc, after which the current density is dropped to 15 amperes per square foot. The advantage of electro-zincing is that it is free from the tendency of hot galvanising to form an alloy of zinc and iron of appreciable thickness, which reduces the strength of the metal. In electrolytic galvanising no such effect takes place, and, in consequence, articles of small section can be coated without deterioration. For hard steel wire, which would be annealed by any process involving dipping in melted zinc, an electrolytic process is evidently well suited.

A neat application of electro-deposition to the accurate reproduction of form has been made in the Cowper Coles process for preparing metallic mirrors of large size suitable for searchlight reflectors. By this method a glass matrix is cast and worked to a perfect optical surface. This surface is made conductive by depositing on it a thin film of silver by an ordinary chemical silvering process, and on this copper is deposited electrolytically. The disc of copper thus obtained is removed, and has, of course, the precise figure and polish of the glass matrix. To prevent tarnishing, the surface is finally protected by electro-plating it with palladium.

The electrolysis of water and the production therefrom of hydrogen and oxygen has en-

gaged a good deal of ingenuity. Simple as the operation seems, it offers a certain scope for invention. To translate the ordinary laboratory voltameter, with its platinum plates dipping in dilute sulphuric acid, into an industrial apparatus requires something more than simple enlargement.

Platinum electrodes are evidently out of the question, and lead is not completely satisfactory as a substitute. But if an alkaline electrolyte is substituted for an acid liquid, iron electrodes can be used. This seems to meet all reasonable needs, but there is more behind. As it is necessary for economy of current to keep down the resistance of the decomposing cell, the electrodes must be close together; as a result there is a considerable chance that each gas will be mixed with a little of the other, a most undesirable state of things for safety. For securing good separation of the electrodes, and at the same time keeping the distance between them small and the resistance low, a metal diaphragm instead of one of glass, stoneware, or the like has evident advantages. Such a partition, if placed between the electrodes, can be prevented from acting as an intermediate electrode (in which case it would generate gas on its own surfaces and cause the production of mixed gases in each compartment) by the device of keeping the voltage between it and each electrode in turn below the critical voltage for the decomposition of water. For this purpose the total voltage between the electrodes themselves must not exceed 3 volts, the drop of pressure from anode to the metal diaphragm and from the metal diaphragm to cathode being equally divided.

Electrolytic oxygen and hydrogen may be made in this manner sufficiently cheaply to be applied as fuel for special purposes as well as for the usual employments of these gases, as for example, the filling of military balloons and for laboratory and medical use.

I can only allude briefly to the use of electrolytic methods for recovering gold from cyanide solutions, which has been of great service to the gold industry, as it has allowed of the use of cyanide solutions considerably weaker than can be effectively employed when the gold is precipitated with zinc, without the aid of an external current.* In the Siemens and Halske process, the cyanide liquors are electrolysed between iron anodes and lead cathodes; the latter are cupelled when enough gold has deposited on them. In the Andreoli process, lead peroxide anodes are used and iron cathodes, gold being stripped from these by dipping in a bath of melted lead which, when rich enough, is cupelled. By using aluminium cathodes Cowper Coles obtains gold sufficiently coherent to form a coating on the plate, but not so adherent as to prevent from being stripped mechanically, the method having the advantage of yielding the gold unmixed and practically pure.

The problem of producing baryta cheaply has been attacked electrically. The process being tried at Niagara Falls consists in heating heavy spar with carbon in what is practically an electric furnace, rather resembling a furnace for block carbide (see Lecture III.). It is said that in this way a mixture of barium oxide and sulphide is obtained, and that from it barium hydroxide can be crystallised. There are several points which are obscure in the working of this process, but on account of the great cost and difficulty experienced in producing baryta by the ordinary chemical methods, any new method must be welcomed.

An interesting process which is important rather from its potentialities than from its output at the moment, is the production of nitrates from air. The principle, viz., causing oxygen and nitrogen to burn together in an electric discharge of sufficient power, is well-known, and has a familiar application in laboratory practice in the preparation of inert gases, argon, and its relatives, from the atmosphere. To pass from this experiment to a manufacturing operation is not quite an easy matter, and the plant when I saw it, about two years ago, at Niagara Falls, certainly showed much ingenuity. In this, air was burned by a great number of small thin arcs produced between platinum points on a vertical cylinder opposed to similar points on a vertical revolving spindle. A continuous current, at a pressure of 10,000 volts, was used, and in the apparatus I saw the current used was about $\frac{3}{4}$ of an ampere, corresponding with about 10 horse-power. Air is drawn through the arcs and into a tower supplied with caustic soda; the oxides of nitrogen are absorbed and a mixture of sodium nitrate and nitrite is produced; the plant described is stated to yield about 10 tons of nitrate per year. It is scarcely necessary to enlarge on the value of any method which can supply at a cost below that of natural nitrate of soda and sulphate of ammonia from fuel, a product containing

* Recently improvements in the zinc process of precipitations have gone far to put it on a par with electrolytic methods.

nitrogen available for nourishing plants. The same principle of burning nitrogen by an arc has lately been applied to the production of oxides of nitrogen for bleaching flour.

The application of electrolytic methods to the production of organic substances has had a certain industrial success. Apart from purely empirical processes, such as the tanning of leather (of which little has been heard lately) and the purification of juices to be boiled down for sugar, there have been put forward a good many methods more easily understandable. In general, electrolysis is used to carry out simple reductions or oxidations, and it is in the dye trade that the method flourishes. Such operations as the reduction of nitro-benzene to amido-phenol, azo-benzene and aniline may be performed electrolytically. The outcome of the method is substantially the same as that obtained by chemical means, and choice between the two modes of arriving at the same goal is governed purely by their cost.

The manufacture of iodoform by the electrolysis of potassium iodide in the presence of acetone or alcohol has been in use for some years. Dr. Mollwo Perkin, to whom I am indebted for much valuable information concerning the electrolysis of organic substances, cites experiments by Abbot, who finds that acetone gives a poor yield unless great care is taken in adding it to the electrolyte. Modern instances of methods of oxidation performed electrolytically are the conversion of anthracene into anthraquinone in the presence of a chromium salt which acts as an effective carrier of oxygen; of orthotoluene sulphonamide to saccharin in the presence of a permanganate. This use of some element such as chromium or manganese, whose compounds are labile, and in passing from one stage of combination to another liberate or absorb a fixed quantity of energy, is a neat device for oxidising or reducing the substance under treatment to a determined point. The energy is supplied by the current, but the steps in its application are fixed by the nature of the intermediary substance. It is as if one were to provide at an electric power station current at a given pressure and to direct it to its proper purposes by stepping it up and down. The analogy is not exact, but it may serve.

A good instance of the adaptability of electrolytic methods in organic work is supplied by the oxidation of anthracene to anthraquinone. In the ordinary chemical method a mixture of chromic acid and sulphuric acid is used, and the oxidising action of the current has been tried instead of this. But as this does not work well, the old plan has been re-adopted, with the difference that the chromic acid is regenerated electrolytically. In this operation the spent chromic salt is electrolysed in a cell with a diaphragm (to prevent reduction of the chromic acid as it is formed), and oxidation proceeds smoothly. But during this process sulphuric acid migrates into the anode compartment faster than the chromium, and the concentration of the acid in the cathode compartment is correspondingly diminished. As the cathode liquid is afterwards transferred to the anode compartment, its poverty is balanced by the migration of sulphuric acid referred to above. In this way not only is oxidation effected, but also a correct proportion of sulphuric and chromic acid is preserved. An alternative process has been devised by Därmstadter, in which the whole operation of regeneration is carried out in a cell without a diaphragm. Evidently the success of this process must depend on the concentration of the liquid in chromic acid; with a weak solution it is feasible enough, but with a strong solution waste of current must certainly ensue. Other labile compounds, as, for example, cerium salts, have been proposed in place of chromium. Their utility cannot be decided on *a priori* grounds, but only by experiment.

Taking the question quite broadly, it may be said that the manufacture of organic compounds, such as chloroform, iodoform, chloral, and the various raw materials of dye stuffs belongs rather to the laboratory than the works. The substances produced are costly, well protected by patents and made in comparatively small quantities. Hence, laboratory methods serve well enough. In the event of a great demand arising for any of them radical changes of method will occur.

Miscellaneous.

TRADE IN ALOES, CIVET, MYRRH, AND INCENSE.

Aden enjoys the distinction of being the export market of four articles of commerce to which no other port can in any way be a rival. These four articles are aloes, civet, myrrh, and incense. One of the oldest drugs known in medicine is aloes, and by far the most valuable aloes come from the Island of Sokotra, which lies just off the East African coast from Cape Guardafui. The drug itself is the bitter

resinous juice of the leaves of the above plant, that has been hardened in the sun. These leaves are of a fibrous, fleshy nature, and, in addition to the juice, the natives make this fibre into rope, many insisting that it makes a better rope than hemp. The drug is brought to the Aden market by the natives in dhows. It is there repacked and sorted, and shipped to customers abroad. During the year 1903, there were 283 cwt. exported from Aden, of which 260 cwt. were sent to Europe—mostly to London.

Civet is a pasty yellowish substance, that is taken from a pouch near certain glands of the civet cat, which is found in Abyssinia. It is first of a yellowish colour, and this gradually turns darker. It has a strong musky odour, that to many is very disagreeable, but by many of the women in Arabia it is considered an indispensable article in the perfumery line. Consul Masterson, of Aden, states that it is rather hard to get a pure article of civet in the market. On account of the rather limited supply and its corresponding high price, much of it is adulterated with lard, butter, ghee, and other greasy substances. As civet is one of the essential ingredients of nearly all the high-class perfumes made, there is always a ready sale for it in the market. The Abyssinians put this civet in small cattle horns, which are packed in cases.

Myrrh is a gum resin that exudes from the cracks of a tree found in Arabian and East African countries. It flows rather freely, but the natives in order to get a larger supply of the article often bruise the trunks of the trees with stones. The myrrh tree itself is a low tree, growing about ten or twelve feet high, with thorny branches. When the myrrh first exudes from the tree it is of a yellowish, whitish, buttery consistency that gradually hardens, and assumes a reddish, semi-transparent colour. It is used principally as one of the components of incense, and the best quality of it comes from the Somali country and Lower Abyssinia, near Harrar. It is brought into the Aden market during the months of November, December, and January, where it is sorted into three grades—light, medium, and dark—and packed for shipment into casks weighing about 168 lbs. As it comes into the market it is of an irregular shape, and somewhat resembles in appearance gum arabic, but the taste is quite different, as myrrh has a bitter flavour and a peculiar odour. It is impossible to state the exact amount of the article shipped from Aden. The returns from 1903, after enumerating other kinds of gums, do not classify myrrh under a separate head, but the items "gums and resins other sorts." Under this class were exported 15,353 cwts., and of this amount it is stated that 12,000 cwts. were gum myrrh. This gum, in addition to its use as a mixture for incense, is valued by the natives of Arabia as a great pain eliminator, and no matter whether a person is suffering from a fresh cut, a bruise, rheumatic pains, or pains of any other kind, an application of myrrh is always thought to afford relief. It has been said that the Chinese mix myrrh with cattle food to give to milch cows, to improve the quality and increase the quantity of the milk. The Somali women put myrrh with water into a bottle, which, on being well shaken, produces a lather that they use as a dressing for the hair. The Abyssinians, when they go elephant hunting, smear themselves with this gum, or a solution of it, as it is supposed to keep the elephants from attacking them, possibly on account of the odour. The greater part of the gum myrrh is shipped to Marseilles, Trieste, and Bombay.

Broadly speaking, the word incense, as generally used, applies to a manufactured or prepared article that is used in worship by many religions, and the word frankincense applies to a particular gum that is the principal component of incense. Commercially, however, the word frankincense is never used, and incense is the term used to denote the resinous pear, or tear shaped gum, that exudes from a tree that is found in considerable quantities in British Somaliland, extending from near Berbera to within a short distance of Cape Guardaufi. There is some little incense that comes from the neighbourhood of Maskat. This, however, is said not to be of so good a colour or quality as the incense from the Somaliland, and there is some inferior incense found in certain parts of India, but the best and the greatest quantity comes from British Somaliland. The incense tree never attains to a height of more than twelve or fifteen feet. It is a squatty, thorny tree, unsightly—like the myrrh and acacia—and again like them, grows in a desert country. Incense is commercially divided into three grades, according to its colour—a bright yellow, a medium, and a dark yellow. It is not only used in worship, but many Orientals use it to sweeten the breath, and burn it in their houses to kill disagreeable odours. The crop varies from 20,000 to 30,000 cwts., and is gathered in the autumn, and brought to the Aden market by the Somalis during the winter months. The higher priced incense is shipped in boxes of a hundredweight, and the cheaper kind in bags of a hundredweight. Incense is extensively used all over the East, and last year 13,337 cwts. were shipped to Bombay, which is a great distributing point, and 12,740 cwts. to European ports, the greater portion of it going to Marseilles and Trieste.

THE PRODUCTION OF FISH MANURE AND OIL IN SAGHALIEN.

A great demand exists in Japan for fish manure, and oil obtained by pressure from the fish used for manure which, when properly refined, is used as a lubricant, and for other purposes. In Saghalien, leases of fishing stations are granted by the Russian Government at a fixed annual rental. A tax of about five farthings for every 36 lbs. is levied on the quantity of fish manure exported, and there are numerous other taxes, varying in amount from year to year. The fishermen employed are for the most part Japanese, and the

system adopted in connection with the industry, is as follows:—The fishermen, to the requisite number, are engaged in Hakodate, and sent by steamer, free of charge, to the fisheries, an advance being made to the men for the purpose of supporting their families during their absence. The men, during the period of their stay in Saghalien, are boarded and lodged at the expense of the lessee, medical attendance even being provided. They are accommodated in substantial buildings, and provisions, including Japanese rice, are supplied on the most liberal scale. All boats, nets, and necessary equipments are owned, and supplied to the fishermen by the lessee. At the close of the fishing season the men are given a free passage to Hakodate, and remunerated in proportion to their respective catches. Mr. R. Forster, of the British Consulate at Hakodate, says that during the season, which lasts from the end of April to the end of July, a look-out is kept up night and day, by boats at sea, for herring, that fish being the raw material from which the manure and oil are obtained. Immediately a shoal is observed to be approaching the coast, the fact is communicated to the various stations by signal. So well is the rate of progress of a "run" known, that it is possible to calculate, within an hour or two, the time when the shoal will arrive at any given station. The method of capture is briefly as follows: —From the shore, a net, technically known as a "strike net," extends into the sea to a distance of some 1,000 yards or more. At the extremity of this, although not touching it, is a square sunk net, with subsidiary nets, serving to guide the fish into it. When a shoal of herring is expected, a boat, from which depends a bag net capable of holding 100 or more tons of fish, takes up its position on the seaward side of the sunk net, another boat being placed at the opposite corner. The herrings, swarming towards the coast in such myriads as to render insignificant any catch made in Europe, are diverted by the strike net into the sunk net. As fast as the latter is filled its contents are emptied into the bag net of the seaward boat by the crew of the second, through an aperture closable at will, this manœuvre being repeated until the bag net is full. Another boat then takes the place of the loaded one, which makes for the shore, careful navigation being necessary in order to avoid making a hole in the bag net, by striking a rocky bottom, and thereby losing the catch. On arrival at the beach, the bag net is emptied, and the fish thrown into an enclosure fenced in by laths, some six feet high. On one side of the enclosure are a number of round iron boilers, four or five feet in diameter, erected on built up fireplaces. The fish are taken from the enclosure by removing the laths, and are thrown into the boilers. After cooking, they are put into wooden presses, 2 feet 6 inches square by 2 feet in depth, the sides and bottom of which are composed of slates, with interstices a quarter of an inch wide between them. A lid is then placed on the top, and pressure exerted in a downward direction by means of levers. The oil and water pressed from the fish escape through the interstices in the side and bottom of the press on to a wooden flooring from which a conduit leads to a tank. The tank is divided by a partition, two-thirds its height, into two compartments. The conduit leading from the press discharges its contents into the first compartment, and as that fills, the oil rising to the surface flows over into the second compartment, leaving the water and other heavier substances in the first. The oil is then put into cans and is ready for shipment. Such has been the process hitherto followed, but in the coming season it is intended partially to refine the oil by straining it through coarse Japanese paper previous to canning. The fish after being pressed, form a compact rectangular mass; this is broken into small pieces, which are laid out on straw mats to dry in the sun. When dried, the fish, or, as it now is, fish manure, is packed in straw bales for transport, and is ready for use. From the foregoing brief description an idea will be obtained of the primitive methods employed in this industry, and also of the amount of valuable commercial product which must necessarily be wasted in consequence of the adoption of these methods. By the use of modern machinery a far larger output of fish manure and oil could be obtained from the same weight of fish. Until, however, the Government adopts a more liberal policy by granting reasonable safeguards to those willing to invest their capital in the fisheries on the Siberian coasts, the industry will never attain the importance it deserves.

JAPAN RAW SILK.

The exhibit of Japanese raw silks in the Palace of Manufactures at St. Louis is one of the most complete that has ever been made for any exposition, and includes not only all the important brands and grades, cocoons and filatures, but also a complete collection of models of silk-reeling establishments showing every phase of raw silk production from the egg to the bundle of silk ready for shipping.

One of the most striking features of this exhibit is a series of models showing the life history of the silkworm, very many times greater than the natural size, commencing with the egg, and passing through the several successive stages until the final cocoon is produced. Here also is to be seen enlarged models of cocoons imitating with faithful accuracy all the details of the real cocoon, even to the enclosed pupa, and the liberated moths, both male and female. Surrounding this exhibit is a series of jars containing natural specimens of eggs, worms in all stages, and moths, so that an intelligent comparative study can be made.

On adjacent tables is to be seen a miniature silk establishment, complete in every detail, and which shows both old and new types of silk reeling appli-

ances. These models, in conjunction with the rest of the exhibit, form a section that cannot fail to attract general attention, not only from the educational, but from the technical standpoint as well. While all silk men know that Japan is a large producer of silks in all stages of manufacture, there are not many who have absolutely knowledge of the diversity of brands indicating differences in grade of the raw silks.

A careful study of those exhibited shows that each silk-producing district in Japan yields raw silk having qualities not possessed by the others, and which are to be taken into consideration when selections are being made for any particular purpose.

Of special interest to silk judges and experts is the series of cases showing the several important grades of cocoons, and the raw silk obtained from the same, the most notable being the Tsunomata, Cross-breed (Chinese and Italian); Matamukashi; Como (Italian yellow); Koishimaru, a white variety; Akajiku, white; Onichijimi, white; Seihaku, bright yellow, and a cross breed, pure white, between Japanese and Chinese. An interesting cross-breed is between Turkish and Italian, producing variegated coloured cocoons. This entire collection is from the Sericultural School of Yokohama, and has in all twenty different specimens on view.

The exhibit of the Yokohama Silk Conditioning House is excellent, and its work is illustrated by a series of photographs showing the extent of its operations and cannot fail to elicit praise from all interested in the scientific testing and examination of silk.

The Sanyen Tamaito Association has various grades from the cocoon to the finished filatures, and includes the "Tamamayu," or double cocoon silk for tram, fringes, braids, &c.

The Silk Export Association of Fukui shows various fabrics that are of wide application, including many that are coloured.

Various other similar associations have similar exhibits. The display of the Silk Fabrics Manufacture Association of Kiriu, Japan, is one of the best, and includes many handsome figured effects in colours. The following facts are given:—

PRODUCTION.

	Dollars.
Silk goods	5,500,000
Silk mixed goods	1,950,000
Cotton goods	50,000
Total	7,500,000
Hand looms	21,784
Power looms	224

The collection is made from the establishments of eight exhibitors, and is worthy of close investigation.

Printed silk muslins are shown in profusion, those of Mr. T. Inagaki of Kyoto being of special interest on account of the characteristic designs.

Too numerous to mention as to individuals is a very large exhibit comprising all sorts of garments from kimonos to military uniforms and court dress heavily embroidered, handkerchiefs, bed spreads, waists, scarfs, table covers, piece goods of all descriptions.

From the art standpoint, the products of the Japanese artists stand alone and distinct, and cannot be compared with any other existing standards. —*Textile World Record.*

Correspondence.

STREET CAR AND MOTOR DUST.

With reference to remarks on the increase of street dust, in various towns, in articles in the papers, I fully concur in ascribing it to the action of the new cars and motors on the roads. These roads were not originally constructed for carrying mechanical vehicles, but only horse-drawn carriages, so that they will have, in due course, to be remodelled, and laid anew to meet the change of mode of conveyance.

The wheels of cars and motors fulfil a double, and different function from those of a cart or carriage, as they have to bite the road hard, or dig into it for a *point d'appui*, as well as to support the machine.

In a horse cart or horse carriage, the grip of the road is obtained by the four feet of the animal, and the wheel is left free to support the machine only, and so they have to roll smoothly over, and not grip the road as the motor cars do.

All four wheels of a motor are doing their weightiest to grip the road all round their tyres, but the horse only grips it with two feet at a time, and this surface of contact is of only a small extent, and is as widely separated as the step. The motor wheel acts therefore as a grindstone, or marble cutter, and is driven by power machinery against the road, which it must eventually consume away, and dispense in gravel and dust. The wheels of a horse carriage on the contrary act as conservative agents on roads, on the principle of cricket or garden roller, when they are passive agents of the gardener, or ground keeper, pushing or drawing them.

The nuisance of the motor dust will therefore tend to increase, as those vehicles become more used, and the only remedy that would seem to apply to them, is to make the roads of asphalte or concrete, so as to be impenetrable, or unimpressionable to the scraping action of the car.

WM. J. BLACK, F.R.C.S.E.

2, George-square, Edinburgh.
August, 1904.

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FRIDAY, AUGUST 26, 1904.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

CANTOR LECTURES ON BOOK-PRINTING.

Mr. Charles T. Jacobi's Cantor lectures on "Modern Book-Printing," have been reprinted from the *Journal*, and the pamphlet (price one shilling) can be obtained on application to the Secretary, Society of Arts, John-street, Adelphi, London, W.C. A full list of the Cantor lectures which have been published separately, and are still on sale, can be obtained on application to the Secretary.

Proceedings of the Society.

CANTOR LECTURES.

RECENT ADVANCES IN ELECTRO-CHEMISTRY.

By Bertram Blount, F.I.C.

Lecture III.—Delivered March 14th, 1904.

The Electric Furnace.

An author—to quote from whom I claim the right—once said: "That the function of an electric furnace is to produce a temperature of a degree or in a place unattainable by other means." This rather bald statement is defensible on the ground that it indicates concisely the two chief services which an electric furnace alone can render. When a moderate temperature is needed and where the heat can pass directly in company with products of combustion, there is no particular advantage in employing the electrical method; its use can only be remunerative in a place where fuel is extravagantly dear, and some other source of power unusually cheap, for it must be remembered that when heating is effected by electricity prepared from fuel through the agency of a steam engine or gas engine, not more than 15 per cent. of the heat energy of the fuel will be obtained in the electric furnace supplied therefrom. The high cost of electrical heating is in certain cases more than balanced by the two advantages stated in the definition of the function of an electric furnace; these are, in the first place, the capability of an electric furnace to produce a temperature greatly higher than the highest which can be obtained by the direct combustion of fuel, and, secondly, the possibility by its means of heating a chamber internally without transmitting heat from the outside through the walls of that chamber.

Without seeking to draw a hard and fast line between these two uses, an example of each type may be given. Carborundum is purely a creature of the electric furnace; no other means is known by which a temperature high enough for its formation can be obtained; calcium carbide, made by the direct action of CaO on C, is in the same category. The preparation of phosphorus is an instance of the other kind; this element can be, and has been, prepared for many years without the use of the electric furnace, and the present predominance of electrical heating is due to the fact that the transmission of heat to a charge which must be enclosed in a gas-tight vessel can be effected more economically with moderately dear heat applied internally than with cheap heat, which must pass through the walls of a fireclay retort.

There are two chief types of electric furnace. In the one heat is generated in an arc; in the other there is a continuous core which serves as a resistance. The two types are not completely distinct, because if the core is not perfectly continuous the course of the current will be marked by the occurrence of numerous small arcs. In practice the pure or "toasting" arc (to borrow an epithet due to my friend Mr. Swinburne) is never used. The heat is too valuable, and the arc, though it will still exist in detail, is smothered as far as may be.

The efficiency of the electric furnace is fairly high. Richards has calculated that according to the nature of the operation the efficiency will range from 38 to 76·5 per cent., a result relatively good when the high temperature reached is considered. Already the principles which should govern the choice of type for any given purpose are being studied, an able paper

on the subject having lately been published by Fitzgerald.

One other generality may be made in speaking of the electric furnace: the products, if the temperature is at its maximum, are invariably simple. Ordinary, tolerably complex bodies are broken up, and the residuum consists of a few substances as uncomplicated as silicon carbide. It is interesting to note that no element remains *per se;* carbon is perhaps the least volatile, silicon is certainly volatilised; the metals which are generally regarded as not easily volatilisable are speedily dissipated. The chemistry of high temperatures is extremely subversive of conventional methods of chemical thought.

As it has been my object in these lectures to sketch as far as possible the present position of those electro-chemical industries which are large enough to count, with a side glance at some of those smaller enterprises which from their new use of a principle or their inherent ingenuity are too interesting to ignore, I must for the sake of conciseness put aside further consideration of the principles which govern the use of the electric furnace and come at once to its present applications.

Calcium Carbide. — Unquestionably, the largest application of the electric furnace is in manufacture of calcium carbide. It is interesting to cast one's mind back ten years or so to a time when the substance had scarcely been heard of outside the laboratory. Most extravagant notions were conceived of its production and utilisation, and so easy is it to be wise after the event that even the least sagacious can now perceive the extravagances.

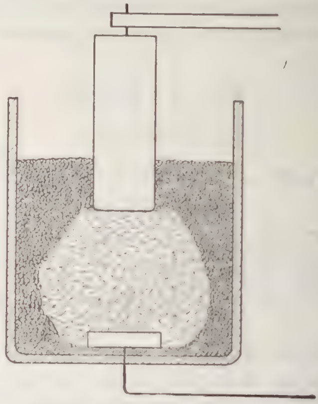
Calcium carbide, as is well-known, is made by heating together lime and carbon, generally in the form of coke, at the temperature of the arc. Any temperature considerably lower seems to be ineffective. Quite lately Moissan has shewn that lime and carbon at the fusing point of platinum do not react.

Calcium carbide furnaces fall into two classes. In one the charge is fused and the product tapped, fresh raw materials being fed in from time to time. In the other no attempt is made to tap the fused carbide, but starting with a small charge, a little pool of carbide is formed; into and around this the raw materials are supplied and the electrode is raised as the melted mass grows, until the vessel holding the charge is filled with a block of carbide. The relative merits of these two types cannot be settled by an *obiter dictum*, but taking the question broadly it may be said that the furnace producing tapped carbide gives the better product, and that the block type of furnace is more economical of energy.

Examples of each type of furnace are shown in Figs. 10 and 11.

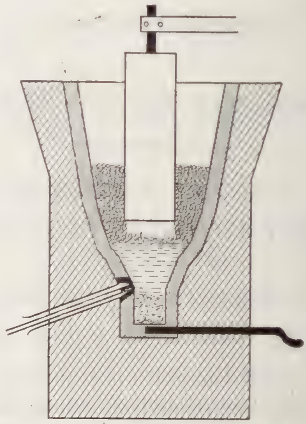
Modifications of each form have been devised and employed with more or less success. One which is in use on a large scale by the Union Carbide Company at Niagara Falls is the Horry furnace; this is practically a circular block furnace, arranged on the periphery of a wheel with a horizontal axis so that each section of the periphery can be brought under the electrode in turn, filled with carbide and moved on. The carbide has time to solidify and cool during the rotation of the wheel, and can be removed when it reaches the side opposite to the electrodes.

FIG. 10.



FURNACE FOR CARBIDE.

FIG. 11.



TAPPING FURNACE FOR CARBIDE.

The manufacture of calcium carbide is in principle so simple that even very crude fur-

naces will produce a fair product. When the industry began, these furnaces were used without much regard for economy; but as time went on and works were freely started, and the price of carbide fell, manufacturers were forced to try to save in various directions. Nowadays a prosperous carbide factory is as well arranged as any other successful works. The lime and coke are crushed, screened, handled and weighed mechanically, and sometimes fed mechanically to the furnaces. The electrodes are chosen with particular regard to their office and both to protect them from oxidation and to economise heat they are kept buried as far as may be in the mixture being fused.

At the best, however, carbide making needs a large amount of power. A year or so ago it was usual to reckon that a horse-power year was necessary to produce a ton of carbide. Now, I am informed, modern works succeed in turning out as much as $1\frac{1}{2}$ ton for the same expenditure of power. Seeing that the cost of power is an important item in the whole cost of carbide, an economy so considerable as this will influence the total manufacturing cost substantially. But though cheap power is a primary necessity of carbide manufacture, yet it would be wrong to conclude that a carbide works, to be profitable, must be run by water power. There are other sources nearly as cheap and in much more accessible situations than those picturesque wildernesses in which torrents are commonly found. The gases from blast furnaces and coke ovens used in explosion engines can furnish power so cheaply that a prosperous carbide industry can be based on the smelting of iron and the carbonisation of coal without impairing the proper conduct of these staple manufactures; the use of their surplus power will be a valuable adjunct.

Carborundum.—One of the most interesting and characteristic products of the electric furnace is carborundum. The furnace used is of the resistance type in which the current is conveyed by a moderately conductive core and the resulting heat is distributed to the charge surrounding that core. The world's supply of carborundum is dependent on only two or three works, that of the inventor, Acheson, being the best known and probably the largest. At the Acheson works at Niagara Falls there were in use at the time of my visit two furnaces, each taking 1,000 h.p. The furnaces are about 30 feet in length and are of the simplest design; they consist of a core of carbon rods, laid zig-zag with cross blocks bridging the angles of the zig-zags, round which is packed the charge of coke and sand,* the whole being supported by a brick box. Just as in the case of the reduction of aluminium, the activity of this great apparatus is not apparent. The heat is well confined and the outside almost cool. When I was at the works I saw a glass bottle containing tea resting on the bricks about four feet from the centre of the charge; a provident workman had discovered that this was an economical method, and did not fear ill effects from overheating. The conversion of coke and sand into carborundum depends so closely on the temperature that it is possible to overheat the product and decompose it; in like manner the outer layers of the charge are not completely converted into carborundum. There is also an intermediate product which has been called siloxicon, and to which the formula Si_2C_2O has been assigned. This substance, though not an abrasive as is carborundum, has uses of its own; it appears to be suitable for furnace linings as it is oxidisable only at high temperatures (Acheson gives 2,674° F = 1,468° C), and in a reducing atmosphere suffers no change until the temperature at which carborundum forms (say 3,000° C) is reached.†

Graphite. — The high and controllable temperature which can be obtained by means of the electric furnace has allowed of many experiments in chemistry at high temperatures. An interesting instance is afforded by the preparation of graphite.

By the courtesy of Mr. Acheson I saw the furnaces in use at his works at Niagara Falls, where graphite in the mass and in rods is produced. The furnaces are similar to carborundum furnaces, and like those have carbon electrodes projecting into a brick box about 30 feet long. Between the electrodes is a core just as in the carborundum furnace but with this difference, that the core is to be the product. Each furnace takes 1,000 h.p. Two

* The charge consists of 34 per cent. coke, 54 per cent. sand, 10 per cent. of sawdust, and 2 per cent. of salt, the two latter being used to keep the mass moderately porous.

† A sample of siloxicon analysed in my laboratory had the following composition :—

Si	46·27
Al	0·33
Fe	0·50
Ca	0·16
Mg	0·07
C	21·11
O (difference)	31·56
	100·00

Corresponding approximately with the formula SiCO.

forms of graphite are made, namely, graphite in mass and graphite rods for electrodes. The raw material is usually anthracite for mass graphite and petroleum coke for electrodes; these latter are moulded in the ordinary way and converted bodily into graphite; they have been used with much success in electrolytic work.

Acheson regards the presence of some substance capable of forming a carbide as essential for the formation of graphite and for this purpose relies on the ash of the anthracite used for mass graphite and on added ferric oxide for moulded rods. His view is that the oxides (silica, iron oxide and so forth) are reduced and converted into carbides, and that these at a still higher temperature are split up yielding graphite and allowing the other constituent again to form a carbide with a fresh portion of amorphous carbon. The process is analogous to what would happen if one continuously supplied carbon to a bath of fused iron and continuously cooled a portion of the bath; the carbon would dissolve in the melted iron and would crystallise on cooling, and the cooled iron would then be returned to the bath and there absorb a fresh quantity of carbon. The theory has much to recommend it, but seems to me to have a difficulty in the fact that after the conversion is complete, the mineral matter practically disappears. It is not quite easy to see why it should wait just long enough for its function and then go. Perhaps it may be that as graphite is the ultimate form of heated carbon and of great stability, the temperature necessary for its formation directly lies above that necessary for the formation of carbides; that the decomposition of carbides occurs at a temperature somewhat below that of the formation of graphite, but above the volatilising point of the other elements concerned; hence, that the very act of producing graphite from carbides involves the dismissal and dissipation of those other elements; it would follow from this that as soon as the mass originally containing some carbide-producing element has once reached the temperature necessary to form graphite by dissociation of the carbide, the constituent other than carbide is gaseous and departs.

Fused Silica and Alumina.—The three substances dealt with above—namely, calcium carbide, carborundum and graphite — are produced by definite chemical reactions only possible at the high temperature of the electric furnace. There are other uses in which no decomposition or synthesis is concerned; they are pure fusions. For example, crystallised alumina can be made by heating any material, such as bauxite, containing amorphous alumina, and is similar in hardness to native corundum; this fused alumina as an abrasive is a rival of carborundum. In the same way fused silica can be prepared, but for a different purpose. Boys showed that fused quartz is an excellent material for many physical purposes, and Shenstone and various continental experimenters have devised methods of working it into vessels of appreciable size. These experimenters have worked chiefly with the oxyhydrogen blow pipe, but Hutton has applied the electric furnace to the same end. The difficulty in the use of the electric furnace is that silica in contact with carbon electrodes or the carbon vapour of the arc is reduced and volatilised; if, however, a current of air is passed through the furnace the trouble is overcome; it would appear that as in the case of other substances such as zinc, the element is more volatile than the oxide. From the quartz threads of Boys to the laboratory apparatus of Shenstone and Heraeus is a considerable step; by the use of a sufficiently powerful electric furnace a much longer step seems within sight. It should certainly be possible to make large cheap vessels for all sorts of purposes, for example tanks and retorts for chemical and electrical use, far more resistant than glass and, on account of the small dilatation of quartz, not liable to crack from rapid changes of temperature. We have almost within our grasp a new structural material.

Carbon Bisulphide.—This substance is well suited for preparation by the electric furnace, because the reaction between carbon and sulphur absorbs heat, which must be supplied from some extraneous source. This heat, if obtained from an ordinary furnace, must be transmitted through the walls of a retort, which should be moderately thin, gas-tight and refractory. Fireclay retorts fulfil these conditions at first, but break or leak after a time; their renewal is a serious item in the cost of manufacture. With electrical heating, the heat may be applied internally, and the envelope may be as thick as one pleases, and may also be cool. A process of this kind has been worked by Mr. E. R. Taylor, and a plant erected at Penn Yan, in the State of New York. The furnace is of the shaft type, about 40 feet in height and 16 feet in diameter, and requires 4,000 amperes at a pressure of 40 to 60 volts. Massive carbon

electrodes are set in the hearth of the furnace, and the carbon which is to be caused to unite with the sulphur, is fed in through a bell hopper like that of a blast furnace. A side opening near this bell allows the carbon bisulphide vapour to escape to the condensers. The sulphur is introduced near the bottom of the kiln into annular chambers which act as a jacket; the temperature in these is sufficient to melt the sulphur and cause it to flow into the zone of action; a certain amount of automatic regulation may be obtained in this way, for if the furnace is running too hard, the flow of sulphur will be over-abundant, and may cover and insulate part of the electrodes. To save the electrodes from too rapid corrosion a secondary supply of carbon in the form of pieces from broken electrodes are fed in through openings immediately above the hearth. It has been found practicable to abolish fixed carbon electrodes, and replace them by a stream of carbon blocks passing down a metallic casing so arranged that the pieces of carbon meet and form a bridge on the sole of the furnace and there come to incandescence. It appears that the electrical manufacture of carbon disulphide is so successful that the supply has for the moment overtaken the demand, and the present need is a new and large outlet for the substance.

Phosphorus.—The economic difficulty mentioned above has been artificially overcome in the case of phosphorus. The demand for phosphorus is practically limited to the match trade, and there seems no prospect of finding another use for this element. The manufacture of phosphorus has always been a close, small and lucrative industry, and when electric furnace methods threatened to swamp the market, control of the patents passed, not unnaturally, into the same few hands. The method of making phosphorus is, in essence, the same as that of making carbon disulphide, except that as none of the materials is as volatile as sulphur there is no necessity for introducing them little by little into the zone of reaction. A charge of calcium phosphate, silica and carbon, or of phosphoric acid and carbon can be packed round a resistance core and there heated until the phosphorus is reduced and distilled.

Iron and Steel.—This is a large subject and of rapidly increasing practical importance. For years inventors have tried to reduce iron ores economically in electrically heated furnaces, and as long ago as 1897 Dr. de Laval showed me specimens of steel thus prepared. But to put a process of this kind on a commercial footing has proved to be a hard problem. The reason is not far to seek. A blast furnace is a fairly efficient machine for utilising heat, and pig iron is a remarkably cheap product. No electrical process using coal for the production of power could hope to compete with it, and the cheapest water power would have scarcely more chance—even if it existed in a district with cheap ore and labour—of turning out pig iron at what may be called a normal industrial price, say 40s. to 50s. per ton. The only prospect of success would be in a district where pig iron from the usual industrial centres was kept out by barriers, natural or artificial.

But in special circumstances, there is sufficient possibility of successfully smelting iron ore electrically to encourage the invention of processes directed to that end. So many attempts have been made in this field, as well as in that of steel making and the preparation of refractory iron alloys, that the time is ripe for an exhaustive and critical monograph on the subject; here I can at most give a few selected examples.

There is no particular difficulty in smelting iron electrically. A furnace of the original Siemens type, or a Willson carbide furnace, where an arc plays between the lower end of a vertical electrode and the fused charge below it, will serve; but such a furnace will need a good deal of modification to make it a practical machine.

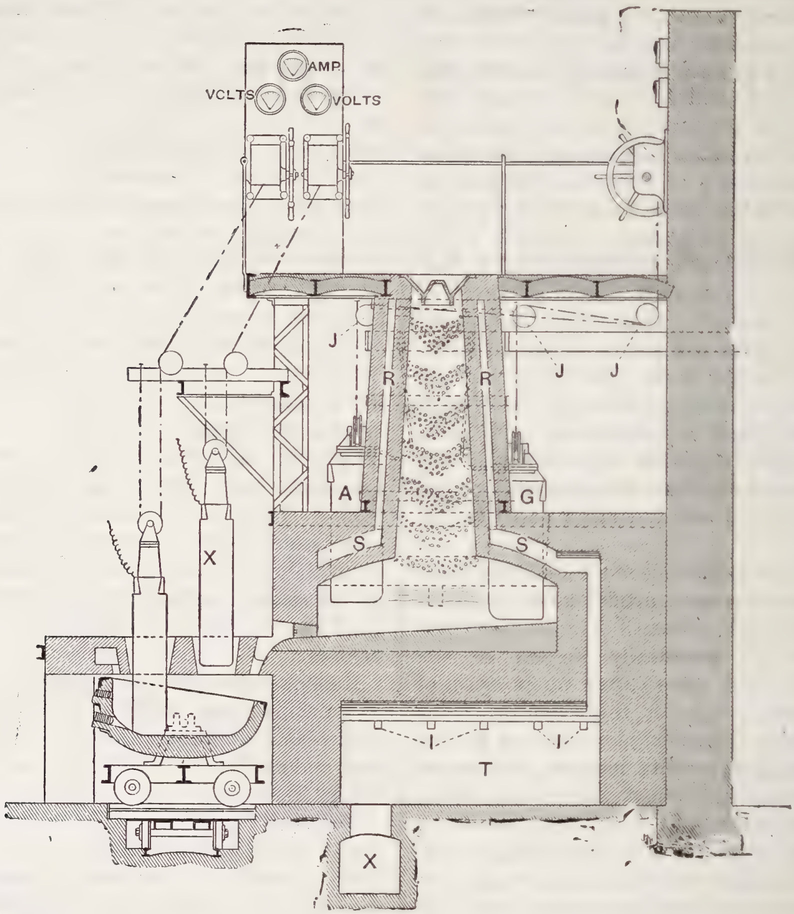
Keller has designed a furnace (Fig. 12, p. 772) for reducing iron ores which somewhat resemble the carbon bisulphide furnace already described. Ore, and carbon for its reduction, are fed down a shaft like that of a blast furnace into a fusion chamber in which are the electrodes. The metal and slag are tapped as in an ordinary blast furnace, and the former passes into a second electric furnace with vertical electrodes. The furnace is shown, and the figure in which the construction is clear. The shaft R R leads to a hearth in which are two electrodes S, S. The pig flows from the hearth into the refining ladle into which a second pair of electrodes dip. This may be regarded as equivalent to an open hearth steel furnace, heated electrically instead of by producers, and in it the melted pig can be converted into steel by the addition of ore and scrap as usual.

Ruthenberg has invented an ingenious process for agglomerating iron ores too finely divided for treatment in the blast furnace; the method is in fact equivalent to briquet-

ting. It consists in passing fine, thoroughly dressed magnetic ores between the poles of an electro-magnet, which revolve, and also act as electrodes of a considerable current. The fine ore sticks to the poles, forms a bridge, and is heated until it is pasty, when it drops into a sacking pit. It is stated that this semi-fused iron oxide is reduced by carbon monoxide circulated through the pit, but considering the ease with which the reduction of iron oxide by carbon monoxide is reversed, I am inclined to doubt the practicability of this stage of the operation. But for briquetting, the process is certainly promising, and if the ore passing between the magnet poles were mixed with solid carbon, reduction in the soaking pit might go on to a point, when a sort of iron sponge would be produced, suitable as a substitute for scrap in any open hearth furnace; the open hearth furnace itself might be electrically heated.

Making steel and special iron alloys electrically is an art more advanced than the reduction of iron ores in the same way. The function of electrical steel furnaces is to keep pig iron fused while it undergoes all the treatment and changes which can happen to it in an open hearth furnace, with the advantage that it is kept out of contact with any foreign matter, including furnace gases.

FIG. 12

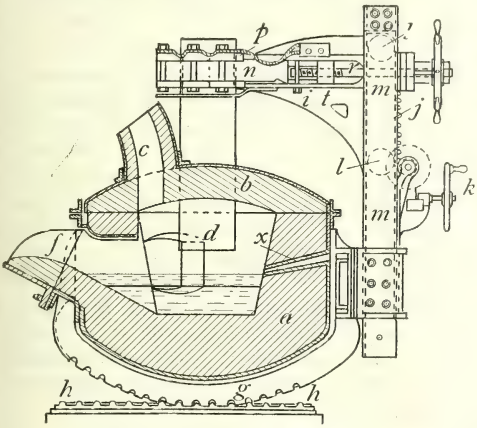


KELLER'S FURNACE.

The Héroult steel furnace design has an iron case with a thick refractory lining, and is arranged so that it can be tilted and its contents poured out. Large carbon electrodes pass through the cover and are carried by the body of the furnace, so that the latter can be tilted without removing them. The principle of the arrangement is clear from the figure. To all

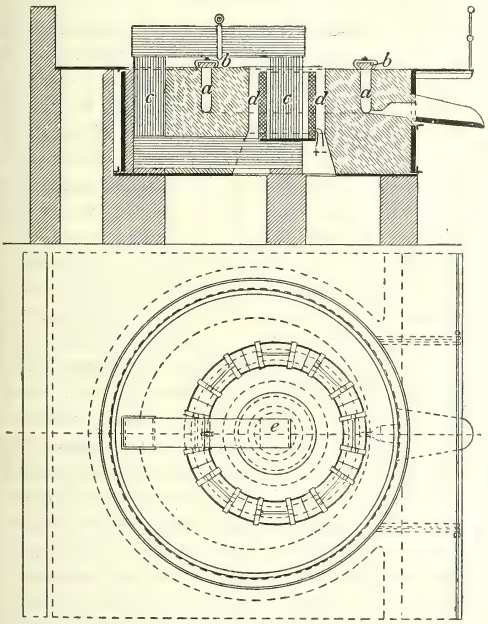
intents and purposes it is a large, shallow Siemens furnace which can be tilted bodily. Scrap and pig iron are melted in the furnace or run in from a ladle or converter as may be convenient, and the mixture is purified from

Fig. 13.



The Héroult Steel Furnace.

Fig. 14.



Kjellin's Furnace.

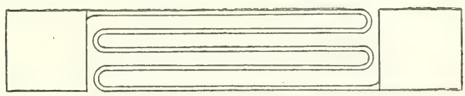
sulphur and phosphorus by lime and other fluxes, and is then appropriately dosed with ferro-manganese, ferro-silicon, ferro-chromium, and so forth, for the production of the particular grade of steel needed. Tool steel has been produced on a commercial scale, and ranks with high-class crucible steel.

Kjellin's furnace is designed for similar work, and has the characteristic of needing no electrodes. The fused metal is contained in an annular space, and acts as the secondary coil of a step-down transformer, having but a single turn. Current is supplied at a high pressure to the primary of the transformer, which of course consists of numerous turns of fine wire. The current generated in the single secondary turn is converted into heat on the spot, and keeps the steel fused. Evidently, provided that the continuity of the secondary turn is not destroyed by ore, slag, or other poorly conducting material, this furnace can be used for all the functions of an open hearth furnace.

In the figure, *d d* is the primary coil surrounding a magnetic core, and *a a* is the secondary turn of fused steel.

A plan with the similar purposes of avoiding the use of consumable electrodes is due to Gin, who makes the metal about to be refined and converted into steel, a continuous resistance between two terminals. These terminals are water-cooled, and the melted metal between them is held in a narrow sinuous channel so as to increase its length, and keep its sectional area moderate; by this means the inconvenience of having to supply a colossal current at a minute pressure is avoided. A plan of the furnace may be diagrammatically represented thus—

Fig. 15.



Gin's Steel Furnace.

The production of special alloys of iron has grown into a considerable industry. Such substances as ferro-silicon, ferro-manganese, ferro-chromium, ferro-vanadium, ferro-tungsten, ferro-titanium have passed or are passing into regular commercial use. It may be said that all these, with the possible exception of ferro-manganese, may be better prepared in the electric furnace than by other means. Ferro-manganese has been made of good quality and high content of manganese by ordinary metallurgical methods, but it is probable that for still higher grades the electric furnace would be preferable. The other alloys named are so refractory that an electrical method of heating is practically a

necessity. The preparation of alloys of this class is effected by mixing the oxides of the two metals with a sufficiency of carbon, and heating in an electric furnace of the Siemens type, if the presence of carbon in the finished alloy is not objectionable. But if carbon is to be absent, either some form of reverberatory furnace of the Moissan type must be used, a system likely to prove too costly, or carbon electrodes must be abolished. This is the real limitation of the use of the electric furnace for the production of refractory materials. We have at present no substance suitable for electrodes except carbon, and all ordinary operations are conducted in contact with carbon or its vapour; a new electrode material is badly needed.

Zinc.—Zinc is a metal for the preparation of which the electric furnace is eminently suited. In the two previous lectures I have sketched methods for reducing zinc electrolytically from an aqueous solution and from a fused bath, and expressed the opinion that useful as both processes might be, they were less generally applicable than a method of distillation electrically. At present, zinc is made by distilling a mixture of zinc oxide and coal or coke in small retorts set in a furnace heated by producer gas. As in all such operations, the cost both of heating and renewing the retorts is high, and there is ample room for economy in this part of the process. A properly contrived electric furnace should certainly prove preferable. Curiously enough, one of the earliest forms of electric furnace was devised by Cowles for the distillation of zinc, and though the form looks crude enough in the light of present day knowledge, yet it clearly embodies a principle unquestionably sound. When it is remembered that the world's output of zinc per year is about 500,000 tons, worth some £10,000,000, it will be realised that a successful process for the electrical smelting of zinc will not easily be cramped by lack of demand.

Miscellaneous.

MANUFACTURE OF ICE IN JERUSALEM.

There is a small ice plant in Jerusalem which has been in operation for three years. An oil-engine of 3-horse power furnishes the power; the freezer is of French manufacture. The sale of ice amounts to about 700 pounds a day, and the capacity of the works is about 1,400 pounds daily. The selling price is about 1¼d. a pound. Never before, says the United States Consul at Jerusalem, have the inhabitants used ice, or seen it in fact. The demand at present is limited, but is steadily increasing. At Jafa, the seaport of Jerusalem, the ice business was established about 1890 on a small scale, and for several years the business was not successful, but in 1899, as the demand for ice was on the increase, the works were enlarged, and since then have been worked very successfully. The engine used is of German manufacture; oil is used for fuel. The present daily demand is for about 1,500 pounds, and the capacity of the works is about 4,500 pounds. The price is the same as that charged in Jerusalem—1¼d. a pound. When the works were first established the price was 2½d. per pound. The water in Jafa comes from wells, and owing to their proximity to the sea, is blackish. The ice is never clear, and when melted, leaves considerable sediment. The water used in Jerusalem is rain water from cisterns, and the ice is like crystal. No natural ice is brought to the country. The demand for ice was first made by the hospitals; the hotels soon after began its use, and now nearly all the foreign residents and many of the wealthy native families are consumers.

THE LINEN INDUSTRY OF BELGIUM.

Flax has been successfully cultivated in Belgium since the earliest period. The area devoted to this special culture has, according to the last agricultural census, 75,494 acres. Linen weaving was in full prosperity long before the introduction of machinery. The progress of the industry has, however, been greatly affected by bad crops for several consecutive years, which also considerably affected the prices of raw material, and so far as concerns the creation of new mills, the industry may be said to have remained almost stationary during the last fifteen or twenty years. The last census shows the number of linen mills in Belgium worked by machinery to have been 28. The first important factory employing machinery was established in 1835. According to this census, 14,084 persons, including 718 mill owners, directors, managers, engineers, clerks, and foremen were interested and employed in the linen industry. About 300,000 spindles are in active operation in the various flax, hemp, and jute spinning mills of Belgium. Besides the extensive manufactory at Ruysbroeck, near Brussels, and annually exporting large quantities of linen of various kinds and qualities, there are important factories situated at Ghent, Courtrai, Liège, Malines, Roulers, Tournai, Boulez, Chaumont-Gistoux, Zéle, Eyne and Lokeren. The flax used in these mills is principally indigenous and Russian flax, with small contributions from Holland and France. About four-fifths of the total output of the spinning mills are exported, the United Kingdom being the principal buyer of Belgium thread, followed in the order of their importance by Holland, Spain, Italy, Germany and France.

Journal of the Society of Arts.

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FRIDAY, SEPTEMBER 2, 1904.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

EXAMINATIONS.

The Programme for 1905 is now ready, and can be had, price 3d., on application to the Secretary, Society of Arts, Adelphi, London, W.C.

The Examinations will commence on Monday, April 10th, 1905.

Important changes have been made in the Examinations this year. These changes, however, affect the classification of the candidates only, not the general system or organisation.

In place of two Grades, Elementary and General, there will be three Divisions or Stages:—

1. Elementary.—Corresponding to the former Grade I.
2. Intermediate. — Corresponding to the Third - class and lower part of the Second-class of the former Grade II.
3. Advanced.—Corresponding to the First-class with the upper part of the Second-class of the former Grade II.

As regards the Elementary Stage or Grade there is no change except in its title.

The old Grade II. has been divided into two parts.

The Examination papers for the three Stages will be separate and distinct. Candidates failing in the Advanced or Intermediate will in no case be granted a lower Stage certificate.

Candidates who have not previously passed in the Society's Examinations are strongly recommended to enter in the first instance for the Intermediate Stage.

Candidates who have already passed the Second-class or Third-class of Grade II. and have made progress, ought to be able to take the Advanced Stage.

The papers set will be of the same character as those of previous years, which will therefore, as hitherto, form a useful guide to the nature and scope of the Examinations.

The following new subjects have been added:—

Elementary Stage—Italian.
Intermediate Stage—Hindustani.
Advanced Stage—Commercial Law, Accounting and Banking, Hindustani.

In the Advanced and Intermediate Stages First and Second-class Certificates will be granted in each subject.

In the Elementary Stage Certificates will be given in each of the subjects enumerated. These will be of one class only.

Certificates of proficiency will be granted in each grade to Candidates who pass in certain specified subjects during a given period.

In Rudiments of Music Higher and Elementary Certificates are given; in Harmony Higher, Intermediate and Elementary Certificates

A fee of 2s. 6d. will be required by the Society from each Candidate in each subject in the Advanced and Intermediate Stages, and in the Elementary Stage a fee of 2s. for one subject, and 1s. for each additional subject taken up by the same candidate. The fees for Harmony and Rudiments of Music are the same as for Stages II. and III.

Medals and Prizes are offered in each subject in Stages II. and III. Full particulars will be found in the Programme.

Examinations are also held in the Practice of Music, and Vivâ Voce Examinations in French, German, Spanish, Portuguese, and Italian. For information as to these examinations reference should be made to the Programme.

THE GROWTH OF THE AUSTRALIAN PRESS.*

The story of the newspaper press in Australia is, in a manner, the history of the Commonwealth itself from the time the first lonely colony was planted on the shores of Port Jackson, thousands of miles from the nearest outposts of civilisation: but it is its history with a difference — not governments and events only (though they have their place), but the conditions of daily life, the thoughts, wants, ideas, the passing feelings of the community are caught and stereotyped for future years.

The world was split in sunder, then, by thousands of miles of sea, across which ships came slowly and at long intervals, so that the story of the world's

* Communicated by Miss Winifred Scott.

events came in disjointed scraps months old before they were received. If an accident happened to machinery, a year might go by before new machinery or requisites came to hand. There was not even a "young reporter," and compositors were few; ink, even, was hard to come by, and the paper supply was a constant difficulty, yet in spite of all they "got the paper out," a few days or weeks late, it may be, and in varying size and colour, yet with marvellous regularity considering all things.

New South Wales.—The first Australian newspaper appeared in 1803, fifteen years after the settlement of New South Wales. A printing press was taken out by the first fleet in 1788, but as no one was able to manage type and press, it was not used in Governor Phillip's time. During Captain Hunter's governorship, a man was found able to print Government orders and proclamations; but it was left for Governor King to institute the first newspaper. In a letter to Lord Hobart, dated May 9th, 1803, he wrote:—"It being desirable that the settlers and inhabitants at large should be benefited by useful information being distributed amongst them, I consider that a weekly publication would greatly facilitate that design; for which purpose I gave permission to an ingenious man, who manages the Government printing press, to collect materials weekly, which, being inspected by an officer, is published in the form of a weekly newspaper, copies of which, as far as they have been published, I have the honour to enclose. . . . . To the list of wants, I have added a new fount of letters which may be procured for eight or ten pounds, sufficient for our purpose, if approved."

The first number of the "Sydney Gazette and New South Wales Advertiser," the earliest Australian paper, was printed on 5th March, 1803, a four-page paper, of foolscap size, three columns to a page. At the head of the first page, beneath the name, was a rough woodcut representing an allegorical female figure seated on a wool bale by the sea shore; on the sea was a ship flying a Union Jack as large as the mainsail; Government House, a fort, a windmill, and a farmer with a plough, took up the middle distance, while picks and shovels figured in the foreground, and round the whole ran the motto:—"Thus we hope to prosper." The contents included Government orders and official advertisements. Ship news took up about one column, an account of a fire another, agricultural notes on the proper method of clearing land, and the advantages of keeping a pig, (doubtless the useful information alluded to by the Governor), one and two-thirds, while extracts from English papers and local news filled up the rest of the paper. The whole was "printed by authority," by George Howe. Howe was a creole, born at St. Kitts in the West Indies, where his father was a printer; he had also worked at his trade in London. He arrived in Australia in 1800. Printer, editor, and business manager, Howe had to face and overcome many difficulties in bringing out his paper. The paper supply was to him as to all early Australian printers a source of constant anxiety. Frequent appeals for paper appear in the advertisement columns of the "Gazette"—"even so small a quantity as a ream will be treated for," says one announcement. Rough sugar paper had to be used more than once. In 1809 the editor remarked:—"A paper in England under 700 is a sensibly losing concern, what must be a paper here with half the number and half of that unpaid for?" This gives some idea of the circulation of the paper, while a public order promulgated by Lieut.-Governor Foveaux gives a glimpse into the state of trade at that time. It was published in December, 1809. "It having been represented that in consequence of numerous sums being in arrears to the publisher of 'The Sydney Gazette and New South Wales Advertiser' the publication thereof is endangered unless those arrears be immediately paid off, His Honour the Lieutenant-Governor is pleased to direct that the stores at the various settlements be always open for the receipt of grain to the amount of sums due upon that account. As it is His Honour's wish to strengthen as much as possible the prospect of its uninterrupted continuance, he is further pleased to recommend punctuality in the discharge of subscriptions, &c." Notwithstanding His Honour's recommendation, subscriptions in arrears, scarcity of paper, and other drawbacks made the life of the "Father of the Australian Press," by no means an easy one. George Howe conducted the "Gazette" till his death in 1821, when he was succeeded by his son Robert. The first newspaper office was a small room at Government House. The "Gazette" appeared for five weeks on Saturday, then for a while on Sunday. It was a weekly paper till 1825, then bi-weekly till 1827, daily for a short time, then tri-weekly till 1842, when it ceased.

Meanwhile there had been other journals in the field. Three newspapers had been started in Tasmania—the "Derwent Star," in 1810, the "Van Diemen's Land Gazette," in 1813, and the "Hobart Town Gazette," in 1816. The second paper printed in New South Wales was the "Australian," managed by William Charles Wentworth, and Dr. Wardell, an English barrister. This paper, which appeared in 1824, introduced political discussion, naturally absent from journals published under the protection and supervision of the Government, and became "the organ of grievances and rights, wishes and wants." Liberty of the press was granted by Sir Thomas Brisbane in 1824, and the new paper was not slow in taking advantage of the opportunity for free expression of opinion.

The "Monitor," conducted by Edwin Smith Hall, which was started in 1826, also took the opposition side. In 1827 the severe punishment of two soldiers, one of whom died in consequence, called forth a warm protest, and a newspaper war; the "Gazette" supporting General Darling, the "Australian" and the "Monitor" taking the other side and attacking the governor and his friends. Darling decided to

make the publication of newspapers illegal unless they possessed a licence, to be renewed each year (at the governor's pleasure), and to impose a heavy stamp duty on each copy published. Mr. Forbes, the Chief Justice, opposed the measure, refusing to certify "an act which made licences resumable at His Excellency's pleasure." The Governor rejoined, "The safety of the colony is endangered by the present licentiousness of the Press, and it would be inconsistent with my duty to await the result of a reference to His Majesty's Government." He transmitted the bills to be signed, urging that Judge Peddar of Van Diemen's Land had sanctioned a much more stringent measure. The Chief Justice still held out. "The Laws of England," he said, "have been declared sufficient to restrain the licentiousness of the Press by the most eminent judges in England; they have proved themselves sufficient on the most alarming occasions . . . Your Excellency is perfectly aware that up to this moment there has not been a solitary instance of prosecution for libel by the Attorney-General, although the safety of the colony is said to be endangered by the licentiousness of the Press." Failing to get the Licensing Act certified, Darling brought forward the stamp duty, sending the bill to the Chief Justice with the amount unstated. Forbes certified that a stamp duty was in accordance with English law, and a meeting of council was held, the blank being filled in with "fourpence." The Chief Justice wrote to Lord Bathurst explaining his action, and the reply showed that legal authorities upheld him. A long controversy ended in the abandonment of the tax. Governor Darling then brought the libel laws into energetic action. The publishers of the two the opposition papers were prosecuted both civilly and criminally. Mr. Hall, editor of the "Monitor" being convicted of no less than seven offences against the libel law, was fined many hundreds of pounds, and received an aggregate sentence of upwards of three years' imprisonment. The publisher of the "Australian," Mr. E. S. Hayes, was convicted of a libel upon the Governor in accusing him of having substituted his own will for the law in the case of Sudds (the soldier who died under correction) and was sentenced to a fine of £100 and six months' imprisonment. Others were dealt with as severely, the cases being tried by military juries nominated by the Governor. There were so many prosecutions for libel during 1828 and 1829 that the court was occupied with them during the principal part of its sittings. Mr. Hall had been in prison for some months when he was released at the accession of William IV.

Other papers which appeared in these stormy times were "Howe's Weekly Commercial Register," published at the "Gazette" office, of which about twenty-five numbers appeared; the "Gleaner," edited by Dr. Halloran, which came out weekly from April to October, 1827, and the "Blossom," which does not seem to have long survived.

On April 18th, 1831, there appeared the "Sydney Herald," which still exists under the name of the "Sydney Morning Herald." A number of other journals, some of them short-lived, were founded in the thirties and forties. Amongst them may be mentioned "The Colonist," started in 1835, and conducted by Dr. Lang, whose trenchant writing often led to libel trials; the "Weekly Register," 1845-46; the "Shipping Gazette," 1843-60; the "Atlas," 1844 (noted for its bold opposition to Sir George Gipps); "Bell's Life in Sydney," 1845; "Heads of the People," 1847-49; "The People's Advocate," 1848; "The Empire," 1852, conducted till 1858 by Sir (then Mr.) Henry Parkes. Discontinued for a while that year, it was revived in 1859 under the proprietorship of Messrs. Hanson and Bennet, being merged in the "Evening News" in 1874—that paper having been started by Mr. Bennet in 1867. It is out of the question to give a list of papers of later date, but a few may be mentioned:—The "Illustrated Sydney News" appeared in 1853; the "Echo" (an evening paper) in 1875.

The oldest existing paper in Australia is the "Sydney Morning Herald," which, as already stated, was founded in 1831, as the "Sydney Herald," and was published by Messrs. Ward Stevens, Frederick Michael Stokes, and William M'Garvie. At first a weekly, in 1833 it was issued twice a week, on Mondays and Thursdays; in 1837 three times, appearing on Mondays, Wednesdays, and Fridays; while in 1840 it became a daily. On February 8th, 1841, the name of Fairfax, now so closely connected with it, first appeared on the imprint of the paper. On August 1st, 1842, it assumed its present name—the "Sydney Morning Herald." The paper was purchased in 1841 by Mr. John Fairfax and Mr. Charles Kemp. The partnership lasted till 1853, when Mr. Fairfax bought Mr. Kemp's interest, and became sole proprietor of the "Herald." A little later he took his eldest son, Mr. Charles John Fairfax, into partnership, and, in 1857, his second son, Mr. James R. Fairfax. These had served their apprenticeship in the "Herald" office, acquiring a full knowledge of the details of the workings of the paper. On the death of Mr. C. J. Fairfax, another brother, Mr. E. Ross Fairfax, was taken into partnership, but subsequently retired. Later on Mr. C. B. Fairfax, son of Mr. J. R. Fairfax, became a member of the firm. Mr. John Fairfax remained head of the firm till his death in 1877, when he was succeeded by Mr. (now Sir) James R. Fairfax, who still conducts it in partnership with several of his sons. Meanwhile the paper had been growing. It had been brought through difficult times by sheer energy and hard work. For five years the results were doubtful, but the early fifties saw the journal firmly established, having surmounted its own difficulties, and survived many of its contemporaries. Till 1856 the "Herald" office was in Lower George-street. The move to the corner of Pitt and George streets was then made. It was on a

Saturday, and on the Sunday morning, as it happened, there came the news of the proclamation of peace at the end of the Crimean war. The news was set up by Messrs. C. and J. R. Fairfax, strips were printed on a galley-press, and taken by the two lads to the churches where evening service was being conducted. The news of the proclamation of peace was read to the congregations and the National Anthem sung. In 1853, the Rev. John West became editor of the "Sydney Morning Herald." He held the post till his death in 1873, when he was succeeded by Dr. Andrew Garran, who was followed in 1885 by Mr. W. Curnow, who has since died. The "Sydney Morning Herald" has always been a free trade paper, has championed the spread of popular education, but, true to its early motto, "Sworn to no master, of no creed am I," it has never been a "party" organ. Printed at first on an Albion hand-press, which was superseded in 1856 by a four feeder Cowper machine, the "Herald" has from time to time made such changes as were necessary to keep the mechanical department up to date. In 1893, two double insetting machines, working at the rate of from 18,000 to 20,000 an hour were introduced. The "Herald" boasts that it is as large as the biggest English paper, and contains even more matter.

The "Sydney Daily Telegraph" was founded July 1st, 1879, by a syndicate including Mr. Watkin Wynne, sub-editor of the Melbourne "Daily Telegraph," and Mr. Angus Mackey, manager and proprietor of the "Bendigo Advertiser." Mr. J. R. Carey, Mr. J. J. Casey, and Mr. Robert Sands were directors. Mr. Lynce was the first editor. In June, 1883, Mr. Mackey retired from the management and Mr. Wynne became general manager. On January 1st, 1884, the paper was taken over by a company consisting of the original proprietors and some others, Messrs. Carey, Sands, H. Gorman, George Pile and J. S. Robertson being directors. Mr. Ward and Mr. Briant of the "Sydney Mail" and "Echo" (now a member of the staff of the London "Daily Chronicle") became editor-in-chief and news editor, and the paper was reorganised throughout, short paragraphs taking the place of solid columns of reading matter. Liberal, not to say Radical, in politics, the "Telegraph" was a supporter of trades unionism till 1890, when the shipping strike showed the aggressive features of the new unionism, which the "Telegraph" strongly opposed.

Tasmania.—In the same year that the "Sydney Gazette" appeared, Tasmania, or as it was then called Van Diemen's Land, was colonised, the settlement being hastened for fear of French occupation. In the "Sydney Gazette" of June 12th, 1803, there is an account of the departure of the *Lady Nelson* for Van Diemen's Land with a small party of convicts under Lieutenant Brown. They attempted to establish themselves on the banks of the Derwent but met with fierce opposition from the natives. In 1804 Colonel Collins, who had failed to form a settlement at Port Phillipe removed to Van Diemen's Land, going further up the river than the first arrivals. Taking Lieutenant Bowen's party with him he formed a settlement at Hobart Town, where the combined forces could better hold their own against the natives.

Lieutenant-Governor Collins had brought out a press and type with which Government orders were printed—at first, we are told, "under a tree in the woods." In 1810 the first Tasmanian newspaper "The Derwent Star and Van Diemen's Land Intelligencer" appeared. It was published "by authority," edited by G. P. Harris, Deputy-Surveyor-General, and printed by J. Barnes and G. Clarke at the Government Press, the first number being dated January 8th, 1810. The "Sydney Gazette" of September 1st, 1810, described the "Star" as a "neat publication published every fortnight on a quarto size." The price was 2s. a copy. There was little scope for a paper, the settlers were not literary, events were few, and politics naturally a forbidden subject, so the "Star" fell back on anecdotes with which to fill up its by no means extensive space—two pages about one foot square, two columns to a page. Type does not seem to have been plentiful; on one occasion the printer stated that owing to lack of type "several interesting extracts" were perforce held over. No. 7 told of the death of Lieutenant-Governor Collins, and only two more numbers (nine in all) appeared.

In 1814 a second attempt to found a paper was made, this was the "Van Diemen's Land Gazette and General Advertiser." The first number was dated "From May 14 to May 21; No. 2, "From May 21 to June 4." It was published under authority and printed by G. Clarke. The last number appeared on September 24.

In 1816 a third paper made its appearance, "The Hobart Town Gazette and Southern Reporter." This was also "Published by authority." It came out in manuscript for the first few numbers, No. 4 being the first printed copy. The printer was Andrew Bent, who had been Clarke's assistant. From the complaints that appeared from time to time in the columns of the "Gazette," it would seem that the typographical part of the work was carried on under difficulties. There are promises of enlargement when a new fount of type came to hand; the paper came out a little later in the glory of new type, only to revert for some reason to MS. for a while; at other times lack of lower case led to the occasional use of capital letters in the middle of words. Being "Published under authority" involved vigorous censorship, as may be seen from the following, which appeared at the end of the second page of the "Gazette" for September 6, 1817:—"The District General Muster occasioned the absence of all from the secretary's office before this page was set; hence the horrid stuff to be found in it." The arrival of a new press and extra type enabled the "Gazette" to come out as a four-page paper in 1823, and it was again enlarged in the following year. In 1825, the printer gave the follow-

ing account of his past difficulties:—"Few, except ourselves, can comprehend even a tithe of the difficulties which, ten years ago, we had to grapple with, our type was so limited that we could not compose, at once, more than is contained in one of our present columns. There was no printing ink in the colony but what we were necessitated to manufacture in the best possible manner for ourselves, and common Chinese paper (no more than half the size of foolscap, and of which two sheets were consequently obliged to be pasted together for each 'Gazette') cost two guineas sterling per ream." Non-payment of subscriptions was a constant source of aggravation, but worse troubles were in store for Mr. Bent and other Tasmanian printers. Mr. Emmet, the first editor of the "Hobart Town Gazette," had found safety in articles described as "brief, mild, and complimentary," but, when in 1824, the "Gazette" was no longer under Government control, and the editorial chair was filled by Mr. Evan Henry Thomas, a more vigorous policy was adopted. Mr. R. L. Murray, under the signature of "A Colonist," wrote a series of letters which were supposed to approach the style of "Junius," but unfortunately offended Colonel Arthur, whose administration had been severely criticised throughout. One of the letters took up three columns of small print. In August, Bent was tried before a military jury, and found guilty of libel, the writer of the letters being called as a witness against him. Nor did his troubles end here. Mr. Bent was obliged to give up the title of the "Hobart Town Gazette," as this had been adopted by the new Government paper; he therefore changed the name of his journal to the "Colonial Times." The "Times" was not fated to lead an untroubled existence. In 1827 "An Act to regulate the Printing and Publishing of Newspapers, &c.," was passed requiring the printers to obtain a licence, which was held practically at the Governor's pleasure, authorised a tax of 3d. each and took securities for penalties. Being in danger of a heavy fine for printing the paper without a licence, Bent hit on the expedient of bringing out the "Colonial Times" with the news column blank. This was continued for over three months. Meanwhile, the unlucky printer applied for leave to conduct a paper, having his sureties ready, but the licence was refused, first to Bent, afterwards to Mr. James Austin, to whom it had been handed over, the reason given being that Bent was to have been employed as a printer. While in prison he started the "Colonial Advocate," which was also suppressed. In 1829 the British Ministry repealed the Licence Act, but the unfortunate printer never recouped himself for his losses, and passed his old age in poverty. Others suffered, too—Mr. Henry Melville was fined £200 and imprisoned for twelve months, and Mr. Gilbert Robertson, editor of the "Colonial Times" and the "True Colonist," was also fined and imprisoned.

In 1825, George Howe, the son of the printer of the "Sydney Gazette," started the "Tasmanian" in Launceston. It was removed to Hobart Town. There, together with Mr. Ross, he became printer of the "Government Gazette." "In necessary things Unity; in non-essentials Liberty; in all things Charity," was the motto of the "Tasmanian," which tried to steer a middle course between the Government paper and Bent's paper, the "Colonial Times." In August, 1827, the "Tasmanian" passed into the hands of John Campbell Macdougal. "Murray's Austral Asiatic Review" was announced to appear in 1829, but was amalgamated with the already existing paper, which came out under the new title of "The Tasmanian and Austral Asiatic Review." "There are now three weekly papers in this little island," wrote the editor, "and we believe a fourth is about to come into existence in Launceston." The price of the "Tasmanian" was 1s. Under R. L. Murray and J. C. Macdougal it continued till 1831, then, edited and published by Murray, it appeared on Saturdays as the "Tasmanian and Southern Literary and Political Journal."

The "Launceston Advertiser" was started in 1829 by John Pascoe Fawkner, a hotel-keeper, self-educated but enterprising, who, later on, played a part in connection with Press and politics in Victoria. "Harmony" was the motto chosen by the new paper, the editor feeling it his duty "rather to promote goodwill and fellowship than to fan the flame of animosity." In March, Mr. Fawkner, together with other printers, had to appear before the Chief Justice "in order to enter into sureties to the amount of £800 by himself and two bondsmen; himself £400 and his sureties £200 each in case he should be convicted of any seditious or blasphemous libel that himself or them should pay that amount if cast." Mr. Fawkner sold the paper to Mr. Dowling, who conducted it well till 1835.

Another paper which appeared in Launceston at the same time as the "Advertiser" was the "Cornwall Press," which was established by Mr. G. Dowsett in April, 1829, and was conducted by him with more vigour than grace. After about twenty numbers the "Press" ceased, giving place to the "Cornwall Chronicle," of which Mr. William Mann was the proprietor. The "Chronicle" opposed the "Advertiser," and advocated transportation.

The "True Colonist, Despatch and Commercial Advertiser," founded in 1833, was published daily during 1835; the editor, Mr. Gilbert Robinson, made its columns interesting by publishing heroically candid criticisms of the Government. No charges were too severe to be heaped upon the Governor and the Administration, not even felony.

The "Launceston Examiner," the oldest existing Tasmanian paper (one of the oldest in the Commonwealth), was first published on March 12th, 1842, in the form of an eight page demy folio, appearing on Saturday afternoons. It vigorously supported political freedom, religious liberty, and anti-transportation, and it played no small part in the Tasmanian history which it helped to make. Six months

after its first publication it became a bi-weekly, and in 1853 its size was enlarged to a double demy sheet of four pages, and it was then issued three times a week. In 1877 the "Examiner" became a daily paper, and at the close of 1881 it was again enlarged. The name of James Aikenhead appeared on the imprint as the first printer and publisher of the "Examiner;" he was also the editor, being assisted by the Rev. John West. In the course of a few months Mr. Jonathan S. Waddle, a practical printer, became a partner and assumed business charge of the paper, and on his death his place was taken by his nephew, Mr. Henry Button, who had served his apprenticeship in the office, which he entered in 1875. Later on Mr. James Aikenhead retired in favour of his son, Mr. William Aikenhead, who, in 1887, disposed of his interest to his partner, Mr. Henry Button. For many years the editorial duties were undertaken by the proprietors, but as business grew and more oversight was necessary, Mr. William Horne was appointed editor. He was succeeded in turn by Messrs. T. S. Carey, Ronald Smith, and, in 1893, by T. G. Pritchard, the present editor. In policy liberal and comprehensive, the "Examiner" has not failed to sound a warning note when it seemed that Parliament and the people under "boom" influence were engaged in expenditure beyond the requirements of the colony, and heaping up burdens which it has since been found grievous to bear. It has steered an independent course. On January 1, 1903, the "Examiner" was enlarged to an eight-page demy of four columns, 24 inches long, and an eight-column sheet on Saturday. It was the first paper to introduce the linotype machine into Tasmania, and has during the last few months enlarged its premises and made expensive additions to its plant. Altogether in its newspaper and printing establishment over a hundred hands are employed. The weekly journal attached to the "Examiner" is the "Courier," which was launched on January 6, 1901, and since that date it has developed into one of the most popular journals of the island state. The "Courier" contains 44 large pages, eight of which are devoted to illustrations. The pictorial work is made a feature, and has already done much to advertise the scenic beauties of Tasmania.

The "Mercury" was first published on the 5th July, 1854, as a bi-weekly paper, the printers and publishers being Messrs. George Auber Jones and John Davies. Two months later Mr. Jones dropped out of the concern, and on 11th September, 1854, the late Mr. John Davies, father of the Hon. C. E. Davies, and Mr. J. G. Davies, C.M.G., became the sole proprietor. On January 1, 1856, the "Mercury" was issued thrice weekly, and two years later, in 1858, it became a daily. The "Colonial Times" and the "Tasmanian" became incorporated with the "Mercury," on the 24th August, 1857. "The Tasmanian Daily News" and "The Daily Courier" disappeared on 1st June, 1858, and the 1st June, 1859, and later, "The Advertiser" and "The Tasmanian Times." Mr. John Davies lived to see the paper he had founded flourish for eighteen years. He died on the 11th June, 1872, and the paper became the property of his sons, Messrs. J. G. Davies and C. E. Davies, who carried on the business under the style of Davies Brothers. Later on, a limited company was formed, the former proprietors retaining the principal interest, with Mr. C. E. Davies as manager. In July, 1877, a weekly paper, in connection with the "Mercury," called "The Tasmanian Mail," was issued for the first time. The first editor of the "Mail" was the late Mr. J. C. Patterson. The "Mercury" has grown considerably since 1854, at the same time becoming cheaper. Till 1856, the price was 4d., then it fell to 3d.; at the end of 1882, to 2d.; and in October, 1893, to 1d. In 1854, the "Mercury" was printed by hand on an old-fashioned Columbian press; later the proprietor obtained a two-cylinder perfecting machine, printing four pages at once; this was used first by hand power, and later by steam; now, in the handsome office lately erected, a new Goss printing machine gets through its miles of paper at an up-to-date speed.

(To be continued.)

*AN ANTHROPOMETRIC SURVEY: ITS UTILITY TO SCIENCE AND TO THE STATE.**

The principal object of an anthropometric survey is to make maps showing the distribution of physical and other measurable characters of the population of a country. Topographical and geological surveys have already been carried out in great detail by most civilised States, but only a few countries have made more or less feeble attempts to map out the characteristics of their populations with the same precision as they have mapped out their topographical features and their geological strata.

It may be objected that an anthropometric survey would be impracticable and useless because there is not the same permanence in the physique of a people that we find in the topography and in the geological strata. But we know enough of the law of ancestral heredity to be practically certain that the average bodily dimensions of a stationary population will be transmitted with little or no change from one generation to another for vast periods of time, provided the environment or conditions of life remain constant. For example, recent investigations have shown that the physique of the present population of Egypt is practically identical with that of the population 9,000 or 10,000 years ago.

There is, therefore, no necessary lack of the permanency necessary to make a survey of the national

* Paper by John Gray, B.Sc., on the Report of the Committee for the Anthropometric Investigation in Great Britain and Ireland, read before Section H of the British Association at Cambridge.

physique possible. If the environment should not be constant, the stability of the physique would still be sufficient to enable surveys to be taken at intervals of five or ten years.

The Ideal Anthropometric Survey. — In an ideal anthropometric survey statistics would be collected of the complete bodily and mental features and activities of the population in every part of the country. The environment peculiar to each section of the population would also be noted. All characters observed should be capable of more or less precise measurement.

The dimensions of the body can now be measured with the greatest precision. Measurements of physiological activities, such as the acuteness, &c., of the senses, say of sight, hearing and smell, can also be measured with considerable accuracy. Physiological characters are more difficult to measure, but still a fair estimate of the mental characters of a local population may be formed from its occupations and amusements, and from the number of distinguished men it has produced.

The Practical Anthropometric Survey.—In a practical survey we must be content with the measurement of a few characters, in order to keep the cost within moderate limits.

As a practical scheme that might be carried out by the State, I give, in outline, the scheme for a survey of the British Isles submitted to the Privy Council Committee on Physical Deterioration, by Professor Cunningham and myself.

According to this scheme, the United Kingdom would be divided into 400 districts, in each of which a representative sample of about 1,000 adults of each sex would be measured. The whole of the school children would be measured, because a thousand of each sex for each age interval of one year would be required, and this would amount to about the whole of the school population. The survey would be completed once every ten years, and the total number measured in that time would be about 800,000 adults and 8,000,000 children. The work, it has been estimated, could be carried out by a staff of twenty to thirty surveyors constantly employed. The employment of part-time surveyors, such as school teachers, on account of the cost of training the large number required, would be very much more expensive than the employment of a small number of whole-time surveyors.

The following is the list of dimensions to be measured, drawn up by Professor Cunningham:—Stature, chest, weight, head (length, breadth, and height), breadth of shoulder, breadth of hips, vision, and degree of pigmentation.

Environment or conditions of life would also be noted, and much information as to environment could be obtained from statistics collected by other agencies.

A statistical department in connection with the survey would work out the averages for each district, the deviations from the average, draw frequency curves, calculate correlations, and prepare maps.

Utility to Science.—The material thus collected and classified would add immensely to our knowledge of the distribution and origin of the races of our own country. The correlations that would be discovered between the different physical characters and between physical and mental characters would be new and valuable scientific discoveries. The correlations discovered between the physique of man and his environment would throw much light on the nature of evolution. It is impossible to anticipate all the developments that would result from so great an accession to our exact knowledge of man.

Utility to the State.—There has been much agitation recently in this country about physical deterioration. Whether this deterioration is really taking place or not cannot be settled by any anthropometric statistics at present in existence. A more or less probable guess can be made in a few cases. With an anthropometric survey in being the question could be answered in the positive or the negative with certainty. Moreover, by calculating correlations between physique and all probable influences the causes of the deterioration would be indicated.

The importance of such information to the statesman, to the sociologist, and to the public themselves hardly needs to be pointed out. Civilisation has brought so many new influences to bear upon the more advanced races of mankind that we are quite in the dark as to their ultimate effects. Influences may be at work which are steadily driving us by invisible steps on the road to national ruin. The anthropometric instrument would detect these insidious changes before they were visible to the naked eye; statesmen and the public wauld be warned in time, and the degeneration might be arrested before it was too late.

PATENTS AND RECIPROCITY.

The following letter from Sir Lloyd Wise is reprinted from *The Times*:—

At a time when every one is considering schemes for the encouragement and maintenance of our trade, it is, perhaps, not out of place to touch upon certain points connected with the method of promoting industrial activity in this realm by grants of letters patent, a subject included amongst those now receiving attention at the hands of the Tariff Commission.

England was the first country to recognise that inventors who introduced or improved an industry benefited the community, by causing an increase in the trade and employment of the people, and to adopt the method of rewarding inventors by the grant of letters patent securing to them the exclusive right to use their inventions for a limited period. Her remarkable rise to the position of the leading industrial nation of the world has been due more largely than is generally allowed to the adoption of this means of encouraging inventors, the success achieved being commonly attributed rather to natural resources and the

commercial instincts of the people; and it is a standing memorial to the astuteness of the legislators of the time of James I. that, notwithstanding the violent prejudice against monopolies which had been caused by the gross abuse by the Crown of its prerogative, in granting monopolies of various trades to courtiers, and for the purpose of raising money they expressly excluded letters patent for new and useful inventions from the operation of the statute which declared monopolies in general illegal. Nearly every civilised nation has followed our example by granting protectection for inventions.

But whilst an exclusive privilege of limited duration is calculated to enable an inventor to reap a reward fairly proportionate to the benefit accruing to the public from his invention, such privileges have occasionally been so exercised as to have a detrimental effect, owing to greed of owners and attempts to monopolise the home market for imported articles by preventing manfacture in this country. The more important the invention the more disastrous to our trade is such a course likely to prove. In an extreme case it is conceivable that the effect might be to cause an industry to dwindle during the term of the patent until on its expiration the foreigner found himself in practically complete possession of the market. Obviously to admit of such a possibility would be to carry the principle of reward altogether beyond reasonable bounds.

Recourse has in many countries been had to expedients for protecting manufacturers and consumers. Thus a patent is prevented from being utilised to secure a monopoly for imported goods, either by direct prohibition, as in France (subject, however, to international arrangements) and Canada, or by being made liable to revocation on failure to carry on the manufacture within the country after a given lapse of time, as in Austria, Belgium, Denmark, France, Germany, and elsewhere. But our law does not go so far. Under it importation of patented products without manufacture here may go on indefinitely unless some interested party, possessed of ample means and sufficient courage to run the risk, should succeed in satisfying probably the most expensive tribunal in the land—the Judicial Committee of the Privy Council—that the reasonable requirements of the public with respect to the patented invention have not been satisfied.

Under the Patents Act of 1883 the Board of Trade had power, in certain cases, to order a patentee to grant a licence on the application of an interested party. The practice was to delegate to a referee the duty of hearing and reporting on the matter, and then to decide what, if any, licence should be granted. The machinery was found to be needlessly complicated, and in the case of a foreign patentee residing out of the jurisdiction either inoperative or very difficult to enforce. In 1900 the Board appointed a strong departmental committee (of which Sir Edward Fry was chairman) to inquire and report as to this amongst other patent questions, and the Patents Act of 1902 resulted, although its provisions are not entirely in accord with the recommendations of the committee.

Under that Act any person interested may petition the Board of Trade for a compulsory licence, or in the alternate revocation of the patent, on the ground that the patentee has not satisfied the reasonable requirements of the public. Assuming a *prima facie* case to be made out, the petition is (unless the parties come to terms) referred to the Judicial Committee of the Privy Council. If the patent is worked or the patented article is manufactured exclusively or mainly outside the United Kingdom, and the patentee fails to disprove the grounds of the petition, the petitioner is entitled to succeed. The reasonable requirements of the public are not to be deemed to have been satisfied, through default of the patentee to work his patent or to manufacture the patented article in the United Kingdom to an adequate extent, or to grant licences on reasonable terms, any existing industry or the establishment of any new industry is unfairly prejudiced, or the demand for the patented article is not reasonably met. If the Committee be of opinion that the reasonable requirements of the public will not be satisfied by the granting of licences the patent may be revoked; but a patent cannot be revoked until after three years from its date, or if the patentee gives satisfactory reasons for his default.

The Associated Chambers of Commerce recently passed a resolution to the effect that the law should be so altered as to secure the forfeiture of every patent if the invention, though workable in this country, be not worked within a reasonable time. This is a needlessly sweeping proposal, as a patentee who is not mainly interested in manufacturing abroad, if unable to supply the home demand himself, is usually quite willing to grant licences on reasonable terms; and it would be both unjust and impolitic to deprive him of his rights simply because of his inability to manufacture or to induce others to do so. Under such a provision small encouragement would be afforded to inventors of limited means, because it would operate as an incentive to some manufacturers to abstain from taking licences, so as to bring about extinction of the patentee's rights. Indeed, the arguments adduced in support of the resolution were directed against foreign owners of British patents manufacturing abroad and importing into this country, to the serious detriment of our manufacturing industries. The law might advantageously extend to prevent this; also to impose upon foreign holders of British patents conditions analogous to those imposed by the patent laws of their own countries.

It is intolerable that foreign manufacturers should be helped by our patent laws to flood this country with foreign-made wares, whilst their patent laws operate to exclude English-made goods from their markets. Our manufacturing industries are sufficiently handicapped by prohibitive tariffs, but even retaliation in that direction would not suffice to protect them so long as articles unconditionally protected

by letters patent here could be imported. Neither would the consumer be protected; because, competition being shut out, those who purchased the articles could be made to pay such a price as would include any import duty that might be imposed.

It is desirable, then, that our Government should be in a position to secure reciprocal treatment for British owners of foreign patents, and to this end our law might with advantage be so amended as to provide not only for compelling patentees to grant licences, but also, under certain circumstances, and subject to international arrangements, for requiring patented manufactures to be carried on in the United Kingdom, and for prohibiting importation of products protected by British letters patent; all of which might be subject to rules to be made from time to time by the Privy Council or the Board of Trade.

Any such enactment should give ample power of discrimination, so as not to inflict hardship upon and discourage English inventors, as would, for example, such a measure as suggested by the Associated Chambers of Commerce; and, furthermore, should provide a much more ready and economical method of dealing with applications for compulsory licences than the present one, which seems eminently calculated to encourage oppression of persons of moderate or small means by those who command capital.

Seeing that, even in cases bristling with legal and technical difficulties, the Comptroller-General of Patents, or the Chief Examiner as his deputy, has to determine (subject to appeal to one of the law officers, whose decision is final) in every opposed case, whether letters patent shall or shall not be granted at all, there appears to be no valid reason for driving applicants for compulsory licences to so exceptionally expensive a tribunal as the Judicial Committee.

The law relating to compulsory licences would be far less likely to remain practically a dead letter if, with a view to enabling decisions to be obtained quickly and cheaply, it were amended on the lines of the scheme embodied, on my recommendation, in the Canadian Patent Act of 1903, according to which the head of the Patent Office or his deputy (aided, where he or either party so desires, by a specially qualified assessor) is the authority for dealing with applications for compulsory licences, and if the owner of a patent refuses or neglects to comply within a stated time with an order for a licence, the patent becomes null and void.

The aim of any amendment in our law should be, whilst giving the patentee a right free from needless uncertainty, so that he may be enabled to derive due advantage from his invention, at the same time to afford manufacturers and traders an opportunity of readily protecting themselves against any arbitrary owner of letters patent who may seek to exercise the privileges thereby conferred in such a manner as to inflict injury rather than to confer benefit upon the community.

*EVOLUTION OF THE LOTUS ORNAMENT.**

In Egypt the lotus has been represented from the earliest times as real flowers, often together with buds and leaves, or as ornamental patterns. The lotus is drawn as well in the realistic form as in a conventional shape. The flower, figured in the more realistic way, shows numerous petals which are pointed. The petals in the conventional flowers are rounded; often the number of the petals (sepals) is only three. The lotus is often combined with spirals. This occurs especially in the eighteenth dynasty. Not rarely two or more conventionally drawn flowers are placed one upon the other. Many Egyptian ornaments are formed by alternating natural and conventional lotus-flowers or by alternating lotus-flowers and lotus-buds.

In Assyria, where the lotus-ornaments are later than in Egypt, we find also both the realistic and the conventional lotus. The latter is generally called "palmette." In Assyria, as in Persia, the ornaments are often formed by alternating realistic and conventional lotus-flowers or by alternating lotus-flowers and lotus-buds.

Similar ornaments are also common in Cyprus and on the isles off the western coast of Asia Minor. In Cyprus, as in Phœnicia, the conventional lotus often has a peculiar form ("the Phœnician" or "Cypriote palmette"). In Greece the lotus occurs already in the Mycenæan time, but it becomes common there only in the first milennium B.C. There, as in the Orient, we find the lotus in combination with spirals, the realistic and the conventional lotus alternating ("lotus and palmette"), as well as the lotus-flower alternating with the lotus-bud. Many capitals of Egyptian columns have the shape of the lotus flower. Similar capitals occur also in Asia Minor, where they gradually get the form known as the "Ionian capital."

THE PROPOSED BARRAGE OF THE RIVER THAMES.†

Any engineering scheme that offers a solution to the many problems involved in attempts to remove the inconveniences and difficulties attending the navigation of the River Thames, with a view to the proper control of the enormous volume of commerce flowing into and out of the Port of London, has claims on the attention of every individual concerned in the commercial prosperity of the kingdom. I propose to meet these difficulties by constructing across the river at Gravesend to Tilbury a dam or barrage similar to that across the Nile; the foundation of the dam would be in the chalk, of granite and mass concrete, and on top

* Paper by Professor Oscar Montelius, read before Section H of the British Association, at Cambridge.

† Paper by James Casey, M.I.N.A., read before Section G of the British Association, at Cambridge.

a roadway for carriage and ordinary road traffic; the dam would be provided with locks, four in number, each provided with internal gates in addition to the outer ones, in order that these locks may be worked in long or short lengths to suit the traffic. The lengths provided in this way will be 300 feet, 500 feet, 700 feet, and 1,000 feet, and the widths from 80 feet to 100 feet, which will suit present and future steamships. It will be easy to lock the number of vessels passing up and down the river per day (which averages 220), many of these however are small craft; but the lock accommodation could lock three times the number if necessary, the great advantage to the shipping interest being that instead of waiting tides at Gravesend, each vessel as she arrives can be locked in a few moments without delay.

The lock will be worked by electricity generated, and obtained from dynamos operated by the fall of water flowing over the dam, a pilot-tower will be fixed from which the traffic will be worked and regulated, and locks, movable bridges, &c., controlled.

A system of signalling from the barrage to the upper reaches of the river will be employed to notify any heavy freshet coming down the river, so that the sluices may be regulated to maintain the required level in the river to the proposed depth of 30 feet, as well as for securing the approaches to the locks.

The dam will provide a fresh-water basin to the Trinity high-water mark, and the present docks would be accessible at all hours of the day or night, irrespective of tides. The unsightly and foul-smelling mudbanks now laid bare twice in the twenty-four hours would no longer disfigure the river; a fresh-water lake forty miles long would be available for boating and pleasure traffic—thus opening up a new source of recreation and physical exercise to the teeming millions of the metropolis—and provide a supply of water for the new Water Board without going to Wales at a cost of no less than twenty-four millions for any additional supply; the extension of works on both banks of the river will afford facilities for employment to our working population, and enable them to spread and so relieve the congestion of the ever-increasing East End population.

In connection with the dam I propose constructing a tunnel, which will be formed in the solid monolith as the work proceeds, and connected with the existing railways in Essex and Kent, which will enable the military and naval authorities to utilise their base of warlike stores at present in Woolwich, Sheerness, and Chatham, should the necessity arise for this, on our north-east coast, to say nothing of the saving in time and expense from these facilities.

The dam from a strategic point of view affords a valuable solution of the question of the Thames defence by effectually blocking the river, and prevents the approach of any "raiders," submarine or otherwise; and incidentally it provides a grand harbour for the fleet, and a protection against invaders; and, lastly, at a cost of only four millions, as against thirty-seven millions proposed, besides which must be set off prospective enormous outlay for water supply, reservoirs, and other matters which become unnecessary if this scheme is adopted.

IMPORTS OF INDIAN WHEAT.

The following letter from Mr. G. J. S. Broomhall, editor of the *Corn Trade News*, dated from Bunswick-street, Liverpool, August 23rd, is taken from *The Times*:—

Students of the fiscal question and many of your other readers will probably be interested in learning that British India, for three weeks in succession, has been the chief source from which the importing countries have drawn their supplies of foreign wheat. India's shipment this week has not only exceeded the Argentine or Russian quota severally, but has exceeded the contributions of the U.S.A. and Canada combined. Looking ahead through the whole season, it seems likely that India may compete with Argentina closely for the second place as a shipper of wheat, Russia taking first place again, as she did last season.

The following are the exact quantities shipped from the principal sources of supply since the opening of the current cereal year three weeks ago—viz., 783,000qr. from India, 612,000qr. from Russia, 571,000qr. from the U.S.A. and Canada, 499,000qr. from Argentina, 483,000qr. from the Balkan Peninsula, 212,000qr. from Australasia, and 89,000qr. from North Africa, Chile, and other minor sources of supply.

It is true that these figures are not conclusive; but they appear to have some value as indications of what may happen, for it now seems as if the British Empire were about to prove itself practically independent of foreign aid in the matter of its bread supply; the 26,000,000qr. which the mother country requires annually may, under conceivable circumstances, be forthcoming during the current season from India, Canada, and Australasia. It is particularly noteworthy that this result has been brought about without any special inducement such as the present high prices, for when the crops of those countries were planted wheat was still selling very cheaply.

General Notes.

LIÈGE INTERNATIONAL EXHIBITION.—The Board of Education have been informed through the Foreign Office that an Exhibition of works of art, under the patronage of the King of the Belgians, will be arranged in a special pavilion within the exhibition grounds of the Universal and International Exhibition to be held in Liège in 1905. Full particulars as to the conditions attaching to exhibits, which will include Paintings, Sculpture, Engravings, and Architectural Designs, are given in the official regulations, which can be obtained on application to the Consul-General for Belgium, 29, Great St. Helens, E.C.

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THE GROWTH OF THE AUSTRALIAN PRESS.*

(*Continued from p.* 780.)

Western Australia.—The first Western Australian newspaper seems to have been a MS. journal, published in Fremantle at 3s. 6d. a copy. It was discontinued in 1832. About December of the same year the first printing press arrived from Van Diemen's Land, and a small newspaper printed on letter paper, called the "Fremantle Observer," was printed by Messrs. McFaull and Shenton in Fremantle. News being scarce, a Mr. Lamb was asked to contribute something of interest. His writings proved so violent as to necessitate a speedy dissolution of partnership between the printers. Mr. McFaull continued to issue the "Observer," but found it necessary to remove his plant to a place three miles in the bush, at a place called Hamilton Hill. The life of the "Observer" was a short one, as it stopped within twelve months, owing to the publisher's inability to pay the weekly charge of £2 for the hire of the plant. The owner of the press soon after established a paper called the "Inquisitor." Owing to quarrels, this came to a stop. On January 5, 1833, came "The Perth Gazette and Western Australian Journal," conducted by Mr. McFaull. This venture was destined to be more successful than the short-lived "Observer," though the "Gazette" had its share of the vicissitudes which overtook other pioneer journals. The size varied from time to time, and once the "Gazette" came out on brown paper. It was during the first year of its existence that the following paragraph appeared:—"In the hurry of going to press last week we overlooked many inaccuracies, which has amused us as much as it has amused some of our readers. We are glad to contribute in any way to so desirable an end, and we trust, considering the difficulties we have to contend with, we shall not be judged too severely."

In 1836, "The Swan River Guardian" was started by Mr. William Nairne Clarke. The "Guardian" had four pages of three columns each of rather poor type, and the old paper difficulty seems to have caused fluctuations in size. This paper criticised its contemporary with a freedom that more than bordered on abuse, and it was probably not much regretted when, after a year, its short life came to an end. On the 5th of August, 1840, the first number of "The Perth Inquirer" was issued. It was published weekly as a demy sheet, and was sold at 1s. a copy, the price being subsequently reduced to 6d. The "Inquirer" was published weekly by Mr. F. Lochee. In 1846 it was edited, printed, and published by the proprietor, Mr. Richard West Vash, and the following year Mr. W. H. Sholl was editor, and Mr. Edmund Stirling publisher. In 1845 there were two papers in Western Australia, and in 1847 there were three besides "The Government Gazette." It was in 1881 that the first daily paper in Western Australia was started—"The Daily News." Four years later it absorbed "The Morning Herald," a paper that had for some time been published in Fremantle. In 1901 "The Inquirer," which was the initial venture of Mr. E. Stirling and Mr. Lochee, was incorporated with "The Daily News."

In 1864 "The Gazette" was enlarged, and the name changed to "The Perth Gazette and Western Australian Times." In August, 1874, it appeared twice a week. Till the end of 1879 the paper was owned by a large proprietary, including Mr. E. A. Stone, Sir George Shenton, Mr. Sept. Burt, K.C., Mr. Maitland Brown, the late Mr. Charles Crowther, and other well known colonists. At the end of 1879 it was purchased by Mr. Charles Harper, who invited Sir Thomas Campbell to act as editor, Mr. Harper himself retaining the business management. At this time the title was finally changed to "The West Australian," under which it takes its place amongst the great dailies of the Commonwealth.

South Australia.—In most colonies some time had been allowed to elapse between the planting of the settlement and the appearance of the first newspaper. In Western Australia and Victoria the interval was not a long one, but South Australia is probably alone in being able to claim a press older than herself, while her pioneer paper instead of dying an early death, like so many early journalistic ventures in young communities, has continued in unbroken succession to the present day. Vicissitudes, however, were not wanting, nor the difficulties inseparable from the starting of a new settlement. The first number of the "South Australian Gazette and Colonial Register" was published "for the proprietors by William Clowes and Sons, Duke-street, Lambeth, London," on the 18th of June, 1836, before the appointment of the first Governor, or the sailing of the first emigrant ship. The second number of the "South Australian Gazette and Colonial Register" was published in due course in Adelaide on the 3rd of June, 1837. It was printed by Robert Thomas and Co., at their printing-office in Hindley-street. It would have made an earlier appearance had not a considerable amount of type, &c., been carried on by mistake to Tasmania. Even the recovery of this did not remove all difficulties, the desertion of a journeyman printer and the difficulty of replacing him, caused delay, so that though intended

* Communicated by Miss Winifred Scott.

to be a weekly, the appearance of the paper was rather uncertain—June 3rd, July 8th, July 29th, August 12th, September 16th, October 19th, November 11th, and then a gap to January 6th, 1838. The proprietors were Mr. Robert Thomas and Mr. George Stevenson, formerly of the London "Globe," private secretary to Sir John Hindmarsh, the first Governor. The editor, Mr. Stevenson, did his best, with the assistance of Mr. William Kyffin Thomas, then a lad of sixteen, who had had two months' experience in a London printing-office, and whose connection with the paper (except for a brief period) only ended with his death about 40 years later. The arrival of compositors overcame mechanical difficulties. At first official notices appeared under the heading of the "Gazette," the paper appearing under the title of "The South Australian Gazette and Colonial Register" till June 22nd, 1839 (No. 74), when it was announced that in the future the "Gazette" would be published separately;—"'The South Australian Gazette,' therefore, will be published on Thursday, and the 'South Australian Register' on the usual day—Saturday of each week." In 1840 Messrs. Thomas and Stevenson purchased from Mr. W. C. Cox the plant and copyright of "The Adelaide Chronicle," which was incorporated with "The Register." In this year the post of Government printer was taken from Mr. Robert Thomas, and the loss seriously embarrassed the firm. In 1842 "The South Australian Register" and its belongings were bought by Mr. James Allen, formerly editor of "The Southern Australian," who removed the plant to the corner of Rundle and King William streets. In 1843 the "Register" was issued twice weekly, and the following year Mr. Allen tried publishing it as a daily, but the experiment had soon to be abandoned.

Besides the "Register," two other papers had been issued during Mr. Allen's proprietorship—"The Southern Cross" and "The Monthly Times." In 1845 Mr. John Stephens became proprietor and editor, removing the business to Hindley-street. Under Mr. Stephens's hands "The South Australian Register" became a paying concern, but his editorship involved it in libel actions so frequent as to give Mr. R. D. Hanson a standing retainer for the "Register," and law costs were heavy enough to form a serious item even for a prosperous paper. On one occasion, Mr. Stephens being unable to meet a rather heavy bill, his plant was seized and removed to an auction mart. This was not allowed to interfere with the publication of the paper, for permission having been obtained to use the machinery, the printers went on with their work as if nothing had happened. The permission to continue work being withdrawn, next day Mr. George Dehane offered his office to Mr. Stephens, and the "Register" came out safely. In a few days matters were arranged, and types and presses were returned to their owners. In 1850 "The South Australian Register" became a daily paper, and may be said to have been firmly established. Mr. Stephens died that year, the worry and anxiety of his work having done something no doubt to shorten his life. The "Register" was carried on for his widow by Mr. John Taylor who placed it on a firm financial footing. In 1853 the paper was purchased by a syndicate of seven, afterwards reduced to four—Messrs. A. Forster, E. W. Andrews, W. K. Thomas (mentioned above), and J. Fisher. Mr. Forster became editor, and held the post till 1864 when he retired from the proprietary; in 1865 Mr. John Howard Clark bought Mr. Fisher's interest in the paper. In 1877 Mr. Andrews died, and Messrs. C. Day, J. H. Finlayson, and R. K. Thomas were admitted into partnership. In 1878 Mr. Finlayson became editor on Mr. Clark's death. A few weeks later Mr. W. K. Thomas who had been associated with the "Register" for more than forty-one years, died also, and the other three partners undertook the sole control of the business. Mr. Finlayson occupied the editorial chair till in 1899 he was succeeded on leaving for England by Mr. W. J. Sowden who had filled the post of acting-editor during Mr. Finlayson's absence for nearly two years shortly before. Mr. Sowden at the same time that he assumed the responsibility of editorship, became one of the proprietors, Mr. E. K. Thomas being admitted to the firm at the same time. The firm now contains two grandsons of one of the original proprietors. On December 2nd, 1878, the "South Australian Register" published its ten thousandth number; on June 3rd, 1887, it celebrated its colonial jubilee; and on January 1st, 1901, it marked the inauguration of federation by dropping the "South Australian" from its name and appearing as "The Register." The price of the paper has varied with the times. At first 26s. per annum or 6d. per copy ("if called for, 1d. extra if delivered"), it rose to 1s. between 1839 and 1843, fell again to 6d., 4d., 3d. (in 1864), 2d. (in 1882), and 1d. in 1892. The size changed in inverse ratio to the price. It was printed at first on a demy "Stanhope" press. This machine is still in existence, and in working order, having not long ago saved the extra expense of a new election. Voting papers fell short on a Saturday afternoon, when no steam was available and engine-men were away. The senior overseer and another member of the mechanical staff printed the requisite number of forms by the aid of the old hand-press in time for voting to be completed. In 1840 a double-demy "Columbian" press was imported to allow the paper to be enlarged, and since then many are the changes that have been rung on improvements in printing machinery in order to keep pace with the latest models, so that everything shall be up-to-date, from the dozen or so of linotypes, run by electricity above stairs, to the great "Hoe" printing-machines in the basement. All the machinery in the office is worked by electric power. Not with the old press only has long service become a tradition in the "Register" office. Some of the seniors have been able to boast

of 30, 40, and in one or two cases even 50 years' work on the paper. The feeling seems also to be hereditary, the name of "Thomas" has arrived at the third generation in the proprietary, while representatives of the fourth are working their way through the very thorough and varied drilling that has won for the "Register" the reputation of being a first-rate training ground for all-round journalism. Two other papers are published at the "Register" office, the "Observer," started by Mr. Stephens in 1843, as a weekly specially designed to be of interest to country readers, a reputation it has kept up to this day, while adding various attractions in the shape of illustrations, &c. The other associated paper is the "Evening Journal," first issued in 1868.

The second paper to appear in Adelaide was the "Southern Australian," established in 1838. It claimed to be the free press of South Australia. It was issued once a week till 1843, from that year till 1851 twice a week. The publishers were Messrs. A. MacDougal and A. Murray. In 1839, several new papers were started, the short-lived "Egoist," the "Adelaide Guardian," and the "Adelaide Chronicle and South Australian Literary Record," which, as as has been seen, was absorbed by the "Register." Towards the end of this year or early in 1840, an attempt was made to draw attention to the claims of Port Lincoln to become the capital of South Australia by means of the "Port Lincoln Herald," which was issued occasionally. It was published by George Dehane, who later seems to have moved to Adelaide. In 1842, when affairs looked their darkest for South Australia, two short-lived journals came out—the "Satirist," and the "Examiner." The "South Australian News Letter," established in 1844, and "issued occasionally," was published by James Allen. In 1845, Mr. George Stevenson started the "South Australian Gazette and Mining Journal." The "Adelaide Times" was established in 1848 by Mr. Allen, its object being to secure emigrants, further education, remove unnecessary restrictions from colonial trade, and to contradict misrepresentations of the colony. The "Times" was a weekly till 1850, when it came out twice a week from January to April, and then became a daily, but May brought a rush to the Victorian diggings, when the "Times" came out every other day, and retained its hold on its subscribers by starting an "Adelaide Times" office at Forest Creek Diggings. In 1852, the "Register" sent Mr. Parkinson to Bendigo, and the paper sold largely in Golden Gully and the fields generally. Amongst the newspapers published in Adelaide in 1848, were the "South Australian Gazette and Mining Journal," Monday and Thursday (George Stevenson); "The South Australian," Tuesday and Friday (Andrew Murray); "The South Australian Register," Wednesday and Saturday. A "Guide to South Australia," published in 1849-50, mentions "Seven or eight newspapers published in the colony. One daily, the 'South Australian and the South Australian Register,' twice a week; the 'Adelaide Observer,' the 'Government Gazette,' the 'South Australian Gazette and Mining Journal,' and the 'Australian German Post,' each once a week." A few papers were started in the fifties, most of them short-lived. In the fifties, there were the "Examiner," an excellent weekly (Garran) in the Congregational interest; "The People's Journal" (E. J. Peake, M.P.), published by Dehane, King William-street; and the "Sud Australisch Zeitung," which was for years printed at the "Register" office. John Menge, the celebrated mineralogist, was connected with this paper for some time.

At the time of the Crimean War, news came by sailing ship. The time taken on the voyage was 70, 80, 100 days, and so on. The vessels arrived in Melbourne, and the news was forwarded by coasting craft. There was no telegraph. The *Great Britain* was the chief steamer in those days; it brought the news of the taking of Sebastopol, and announced it on a big board, hung over the side, with "Sebastopol Taken," in huge letters that all might read. Later, when mails were landed at Glenelg, and the telegraph laid to Melbourne, the arrival of the mail was the sign for a struggle between representatives of rival papers. Mr. Flood, of "The Argus," someone from Gordon and Gotch and the "Register," joined in obtaining news as soon as possible. The papers were wrapped in waterproof, and thrown to the racing gigs in waiting. Then issued a race for the shore, continued on racehorses when land was reached. At the Adelaide Post-office the Melbourne papers strove as to who should hold the wires, while the "Register" paid overtime in the form of "call-money" to the printers, who struggled with a whole month's European news at once.

The first number of the "South Australian Advertiser" appeared on Monday, July 12th, 1858. Although others were associated with him, Mr. J. H. Barrow was practically the founder of the paper. He arrived in Adelaide in 1852, and accepted the pastorate of Clayton Congregational Church. He joined the staff of the "Register," then the only daily paper, and eventually succeeded Dr. Garran as leader writer. He also went into Parliament. He subsequently became the first editor of the "Advertiser." In 1872, when he accepted office as a Minister of the Crown, he was succeeded by Mr. Harcus, also a Congregational minister and a leader writer on the "Register" staff. Next came Mr. Jefferson Stow, who in turn was followed by Mr. (now Sir Langdon) Bonython, the present editor, who had joined the "Advertiser" staff in 1864, and received his training from Mr. Barrow. The "Advertiser" was started by a company, Mr. Barrow being editor and manager, Sir Henry Ayers, Mr. G. C. Hawker, Captain Scott, and Mr. J. H. Kearns being directors, while Mr. Thomas King was connected with the commercial department. In 1864 the "Advertiser," the "Chronicle," and the "Express" were taken over by a syndicate of eight persons, Messrs. J. H. Barrow, Thomas King,

C. H. Goode, T. Graves, J. Counsell, W. Parkin, R. Stuckey, and G. W. Chinner. In 1871 Mr. Barrow and Mr. King acquired the proprietorship, and about three years later, after Mr. Barrow's death, Mr. King became sole proprietor. A few months later Mr. Burden and Mr. Bonython were admitted to the firm, and the papers passed into their hands in 1884, Sir Langdon Bonython afterwards becoming sole proprietor.

The associated papers of the "Advertiser" are the "Chronicle," which was first issued in the same week as the "Advertiser," and the "Express" penny evening paper, started in 1863 to compete with the "Daily Telegraph," which had been started by Mr. F. Sinnett, who afterwards joined the staff of the Melbourne "Argus." The "Telegraph" was the first penny paper in Australia; it was purchased in 1847 by the proprietors of the "Advertiser," and incorporated with the "Express."

In 1866 there were three daily papers in Adelaide—the "South Australian Register," the "South Australian Advertiser," and the "Daily Telegraph"; three weekly papers—the "Adelaide Observer," the "Adelaide Chronicle," and the "Weekly Mail." There were also weekly papers published at Mount Gambier, Kapunda, and Wallaroo. In 1879 South Australia had about 40 journals. Four dailies (two morning and two evening), five bi-weeklies, twenty-three weeklies, one fortnightly, seven monthlies, and four quarterlies.

Victoria.—Melbourne was, in a great measure, settled from Tasmania, and the first Victorian newspaper was published by Mr. P. Fawkner, formerly editor and proprietor of the "Launceston Advertiser." There was no printing press in Melbourne, but that was not allowed to interfere with the project. The paper came out in MS. as the "Melbourne Advertiser," "written for and published by John P. Fawkner." The first number appeared on Monday, January 1st, 1838. About nine numbers appeared in MS. before press and type arrived, then the "Advertiser" blossomed out into print, but the triumph was short-lived and the journal was discontinued, Mr. Fawkner having received a notice from the Colonial Secretary of New South Wales to the effect that he would render himself liable to heavy penalties if he did not comply with the regulations governing the publication of newspapers. Negotiation in Sydney involved a delay of eight months and in the meantime a rival paper had started. The "Port Philip Gazette" appeared 27th October, 1838. With George Arden, a young journalist from Sydney, as editor, and Thomas Strode, a printer, who had received his training at the "Herald" office in Sydney, the "Gazette" seemed to have every advantage, but in 1839 Mr. Fawkner revived his journal under the title of the "Port Philip Patriot and Melbourne Advertiser." Both papers had to contend with difficulties in the printing department. Two compositors engaged by Mr. Fawkner, and paid by him for some months pending negotiations in Sydney, disappeared before the paper could be resumed, and were difficult to replace. An advertisement for a youth as an apprentice appeared for weeks in the "Gazette" without success, and once the editor had to apologise for the unusual appearance which the "Gazette" had assumed under the hands of a man who had groundlessly described himself as a competent compositor. There were the usual complaints about the difficulty of collecting subscriptions, but the advertisements must have rejoiced the heart of the business manager of the "Gazette," for once two-thirds of a column in the supplement represented the whole of the reading matter, and another time "the leading article, domestic intelligence, and a mass of interesting news from the sister colonies" was crowded out by the all-encroaching advertisements. In 1841, the proprietors of the "Gazette" announced that, owing to the increase of the circulation of their paper, it taxed the energies of the printer's devil and two other boys to distribute it on publishing day. The "Gazette's" remarks upon its contemporaries were, to say the least, caustic. Some sort of amend, however, was made to Mr. Fawkner on his retirement. The "Herald" was the third Melbourne paper. The "Port Philip Herald," which became later the "Melbourne Herald," and after that, the "Herald" was started in 1840, and is mentioned, in 1841, as a leading Melbourne paper. It was conducted after the gold discovery by Mr. F. Sinnett, then by Dr. Evans, of New Zealand.

Geelong once bid fair to become the capital of Port Philip, and the "Geelong Advertiser" was founded in 1840 by James Garrison, in conjunction with Mr. Fawkner. Mr. W. Harrison alone owned and edited it till the sixties, when it passed into the hands of Mr. Alfred Douglass. It is now carried on by his sons, Mr. Percy H. Douglass and Mr. Montague F. Douglass, and has been edited for the last twenty-five years by Mr. Quarrik, formerly of the editorial staff of the "Age" and "Leader." It has the reputation of being ably conducted on n-dependent liberal lines, and exercises considerable political influence. It was edited in the seventies by Mr. (afterwards Sir Graham) Berry, at which time it had strong radical leanings. The jubilee of the paper was celebrated by a public banquet in the Town Hall, at which representatives of all the leading journals in Victoria attended. It is published daily at 1d., and is the oldest morning journal in Victoria, the "Melbourne Herald," founded a little earlier than the "Advertiser," having become an evening paper.

The following account of the Australian press is quoted from the "Port Philip Patriot," 1 January, 1845:—"The good folks of Melbourne (about 10,000) are likely to have newspapers in plenty for the quarter commencing to-day, the 'Patriot' and the 'Herald' in the future appearing three times a week, and a new advertising sheet called the 'Shipping Gazette,' issued from the 'Gazette' office. After this week the following will be the daily publications

of these papers: Monday, the 'Patriot' and the 'Shipping Gazette'; Tuesday, the 'Herald' and the 'Government Gazette'; Wednesday, the 'Patriot,' 'Gazette,' and 'Standard'; Thursday, the 'Herald'; Friday, the 'Patriot'; Saturday, the 'Herald,' 'Gazette,' 'Standard,' and 'Courier'; making in all 13 publications in the course of the week. Of course this won't last above the quarter, but in the meantime it beats hollow all the other publishing towns in the Australian colonies. Sydney, the Goliath of Australian cities, has a fluctuation of about 20; Hobart Town, 8; Launceston, 5; Adelaide, 5; Portland, 3; Geelong, 2; Parramatta, 1; Maitland, 1; Windsor, 1; the colony of New Zealand, 4; and the colony of Swan River, 2."

A writer in 1846-7 mentions four newspapers, the "Patriot," daily, and the "Herald," "Gazette," and "Argus" printed two or three times a week.

The "Melbourne Courier," printed by Samuel Good for William Kerr," was started in 1845 as a tri-weekly, but had not a long lease of life. The "Melbourne Argus," as it was first called, made its initial appearance on the 2nd of June, 1846. It was printed twice weekly, Mr. William Kerr being proprietor and editor. The new paper was as much given to pugnacity and the use of strong language as its contemporaries; libel actions were frequent, law costs and fines absorbed most of the profits, and after two stormy years the "Melbourne Argus" was taken possession of by the sheriff and sold "lock, stock, and barrel" for £300. It was bought by Mr. Edward Wilson, of Dandenong, who dropped "Melbourne" from the title, and brought out the first number of the "Argus" on the 15th of September, 1848. It was published twice a month for some months, then appeared every other day, and on the 18th of June, 1849, it became a daily newspaper. Mr. J. S. Johnston was associated for some time with Mr. Wilson in the proprietorship, but Mr. Wilson was editor, and a vigorous, combative, courageous editor he proved. Under his hands the "Argus" grew and flourished, absorbing from time to time one or other of its weaker contemporaries—the "Courier," the "Daily News," &c. A four-page paper, starting with about nine columns of advertisements, it was not a very paying concern, and there was but little scope for journalistic enterprise. It could at most anticipate its rivals by half a day in publishing the latest news by overland mail from Sydney. But better times were in store for the then quiet little town of Melbourne. There had been rumours of gold discoveries denied, repeated, and at last they proved to be true. Then came the gold rush, Melbourne was almost deserted, and it was not easy to bring the paper out regularly when compositors had caught the gold fever like other folks and preferred picking up nuggets to type. However, the "Argus" was kept going and so shared the rising tide of prosperity which swept over the new colony of Victoria, the population increased rapidly and with it the circulation of the "Argus," which had its agents and its correspondents on every gold-field. A weekly edition came out at 1s., or on the gold-fields 2s. 9d. Impoundings were the chief feature, columns of descriptions of brands which are said to have driven compositors melancholy mad. The growth of local papers on the gold-fields and in other districts removed the necessity for the weekly "Argus," and it was ultimately merged together with the "Examiner" and "Yeoman" into the more comprehensive and popular "Australasian." In the fifties the "Argus" was dependent for its European news upon the arrival of the oversea mails. The arrival of the *Marco Polo*, the *James Baines*, the *Lightning*, the *Red Jacket*, or other fast clippers at the Heads, after a run varying from ten to thirteen weeks, was telegraphed by semaphore to the Observatory which then crowned Flagstaff-hill. The shipping reporter was on his mettle to land his parcel of correspondence as promptly as possible, and as quickly as possible, and as soon as they were landed a crowd would begin to gather round the "Argus" office to wait for the issue of an extraordinary edition containing a digest of the latest news. Sometimes a cheer went up when the sound of the machinery was heard outside, and a wild struggle ensued for the earliest copies issued. In the sixties the "Argus" came into collision with the Legislative Assembly for an alleged breach of privilege, it also had an occasional action for libel, but it prospered none the less and could boast at its jubilee, which was celebrated on the 2nd of June, 1896, that "of all its early contemporaries it is the only survivor." And as it had absorbed the "Port Philip Patriot" which appeared originally in MS., it represents the first journal which sprang into existence in the city of Melbourne. The founder's idea was to give the public a frank and fearless paper, and the "Argus" has not disappointed that hope. The cry of "Unlock the Land" was first raised by the "Argus," and it championed the diggers in their protest against the arbitrary system of issuing licences. The price has varied from time to time: from 1848 to 1850 it was 6d.; in 1851-52, 8d. and 1s.; in January, 1853, 3d.; February, 6d.; April, 3d. In 1884, 2d.; and on the 3rd of April, 1893, it came down to 1d.

The "Age" was first published on August 17th, 1854, the opening day of the first Melbourne Exhibition, the paper being printed in the Exhibition building in William-street. Messrs. Cook Brothers lost a considerable amount over the venture, and in three months the paper was taken over by the *employés*, and worked on co-operative lines. It was not a success, and in June, 1856, plant and copyright were sold by auction, and bought by Mr. Ebenezer Syme and his brother David. At first the paper did not seem inclined to prosper, but the reduction of price in 1858 from 2d. to 1d., led to increased circulation and popularity. Liberal and protectionist in its views, the "Age" speaks with no uncertain sound on political matters. It has also shown enterprise in sending

out exploration parties to New Guinea, and special correspondents to report on agriculture, irrigation, and so on in various countries. In 1891, Mr. David Syme became the sole proprietor.

Queensland. — The "Moreton Bay Courier" (still existing as the "Courier") was the pioneer paper of Queensland. It was founded by Mr. Lyon, who arrived at the then settlement of Moreton Bay early in 1846 (the population of the whole district including Darling Downs was then only a little over 1,500), made inquiries as to the prospects of a paper, and promptly proceeded to start one. Mr. Lyon was editor, Mr. Swan (from the composing-room of Dr. Lang's paper "The Colonist") was publisher, and Dr. Lang, who was warmly interested in the settlement, gave advice and encouragement. The first Queensland newspaper office was a little upstairs room little better than a garret, at the corner of Queen and Albert streets, and the first number of the "Courier" appeared on the 20th June, 1846, the size being four pages demy folio, and four columns to a page. From that time it came out weekly, in spite of friction caused by the fact that in the heated politics of the day the two promoters took opposite sides. As Mr. Lyon favoured the squatters and the re-institution of transportation, and Mr. Swan, backed by Dr. Lang, as hotly opposed it, consistency of policy must have been difficult. In 1847 Mr. Swan took sole control of the "Courier." Three years later Mr. Lyon's friends set him up as editor of the "Moreton Bay Free Press" which, however, only lasted while the hotly contested transportation question was in agitation. In spite of opposition, the "Courier" kept on its way, often sore beset, but generally victorious. In 1853, William Wilks was the controlling mind, and the "Courier's" tendency decidedly anti-church. Five years later the paper became a bi-weekly. Party feeling ran high, and the "Courier's" rivals were strong, but it kept up its circulation, which rose from 200 in 1847, to about 1,000 in 1858, notwithstanding the opposition of the "Free Press" and two off-shoots—the "Northern Australian" (published 1855) and the "Darling Downs Gazette" (June, 1858), also edited by Lyon. The "Courier" is described at that time as "professedly liberal, which meant anti-squatting in the district, and of the Manchester school in other respects." Separation was granted to Queensland in 1859, and the "Courier" which had been published twice a week for a year, celebrated the occasion by coming out thrice in January, 1860. (It became a daily in April, 1861.) The "Courier" held to its rather emphatic politics, though a formidable rival had arisen in the "Guardian," which took the place of the defunct "Free Press." In 1861, the "Courier" passed out of Mr. Swan's hands into those of Messrs. Lilley (ex-Chief Justice) and Belbridge, thence to Mr. T. B. Stevens. The "Courier" met with tribulation in the shape of the first State trial in Queensland. The "Courier" and the "Queenslander" were, in 1861, sold by auction, and purchased by Mr. Baynes for £13,600, and resold by him, at a profit of £2,000, to Messrs. Gresley Lukin, E. J. C. Browne, and W. Thornton, who styled themselves the Brisbane Newspaper Company. Mr. Pugh resigned the editorship, leaving the "Courier" for the "Telegraph." He was succeeded by Mr. W. H. Traill, whose "Specialities" became a feature. They were written during his illness by Marcus Clarke, Brunton Stevens, and others. William O'Carroll again became editor, succeeded by George Hall. Mr. Lukin gave his chief attention to the "Queenslander," which promoted a transcontinental expedition in 1879 under Ernest Favenc. Various changes have from time to time taken place in the proprietary. The paper was increased in size to eight pages in 1881, and the price reduced to 2d. The "Evening Observer," a party organ of the ministry started in Ipswich, after nearly dying of politics, was bought by the Brisbane Newspaper Company, and became the first eight page evening paper in Queensland. The press on which the first "Courier" was printed, was the second made in Australia, the first having been used for the old Sydney "Australian," established in 1824. The whole of the type, too, was of Colonial manufacture, Mr. Alex. Thomson, of Sydney, being the type founder. The "Courier" office claims to have been the first in the southern hemisphere entirely of colonial material. Another daily morning paper, "The Daily Mail," made its *début* in 1903. New journals appeared from time to time, and old ones re-appeared under new titles. The "Weekly Guardian" which had succeeded the "Free Press" was incorporated with the "Weekly Herald," which was published by Mr. Wright, formerly publisher of the "Guardian." It was edited by Mr. Pugh, and contained a good selection of Colonial and English news. The "Queensland Times" was considered to be the organ of the Government. This paper had originally appeared as the "Ipswich Herald" in 1859, and edited by Mr. George Hall. The paper was afterwards sold to Messrs. Parkinson and others, and changed to the "Queensland Times." The "North Australian," also an Ipswich paper, started in 1855, became a bi-weekly in 1858, and was sold to Bishop Quinn to become the organ of the Roman Catholics. Writing in 1861, Dr. Lang mentioned two Brisbane papers besides the "Government Gazette"—the "Courier" and the "Guardian," both published three times a week, and three country papers, the "North Australian" and the "Herald," at Ipswich, and the "Maryborough Gazette," in Maryborough. Mr. Pugh, writing in the same year, mentioned two more, the "Darling Downs Gazette" and the "Maryborough Chronicle." In 1864 the "Darling Downs Gazette" came out twice a week, and the "Toowoomba Chronicle" was enlarged, the "Warwick Argus" (started some time before) was resuscitated, and two new papers, the "Port Dennison Times" and the "Peak Downs Gazette" started.

It is needless to follow the fortunes of each colony

further in detail. As population grew, and conditions of life changed, the Press grew in proportion. The one Australian journal of 1803 stood alone for ten years, then a companion was started in Tasmania, after that the growth was more rapid. If every paper started were to be counted, the number would be considerable, but, as has been seen, they were for the most part of short duration. In 1838, there were 23, in 1845, speaking roughly, 56; little over one for each year since the institution of the Press. In 1888 there were about 514, and five years later there were (omitting Western Australia) 533. The decade from 1893 to 1903 has seen this materially increased, the present number being 856 for the six States of the Commonwealth. A glance at some of the figures may be of interest, as showing the direction in which the newspaper press has developed in the various portions of the Commonwealth.

In 1898, the number of papers in the various colonies was approximately: — New South Wales, 231 (Sydney 52, country 179); Victoria 150 (Melbourne 43, country 107); Queensland 75 (Brisbane 29, country 46); South Australia 52 (Adelaide 23, country 29); Tasmania 25 (Hobart 13, country 12); the number for Western Australia is difficult to ascertain. The number of newspapers shown in State directories for 1903 are: New South Wales, 297 (Sydney, 76, country, 221); Victoria, 298 (Melbourne, 80, country, 218); Queensland, 128 (Brisbane, 36, country, 92); South Australia, 61 (Adelaide, 34, country, 27); Tasmania, 23 (Hobart, 14, country, 9); Western Australia, 49 (Perth, 14, country, 35). The increase in the number of papers is greatest in Victoria, where they have almost doubled—more than doubled in the country. The same thing has happened with regard to country papers in Queensland, the increase in Brisbane being about one-fourth of the original number. In New South Wales the expansion has been less—about one-fourth in the country and one-half in town, a little less than a third in the whole State. South Australia has an increase of about one-fifth of the total, with a decrease in the country. In Tasmania there has been a slight falling off, three less in the country and only one more in Hobart. The increase in Western Australia would naturally be in country districts, as each new mining town promptly starts its own journal, and before long rivalry provides another.

But it is not in numbers only that an advance is to be seen. Many and startling as have been the changes that have come to the conditions of life and work generally, nothing, perhaps, has been so thoroughly revolutionised as the processes by which a newspaper is evolved. Inventions touch other trades here and there, but it may almost be said that the Press has absorbed them all, adding on its own part innovations that would make an old-time printer stare. And though this may be apparent in the old country, the contrast is still more striking where the pioneers had added difficulties to contend with.

In order to appreciate the enterprise of the old pressmen it is necessary to glance back at the conditions under which they worked. The first few years of the 19th century found New South Wales an isolated little settlement on the coast of an unexplored continent, from the interior of which it was shut in by mountains over which a pass had not yet been found, cut off by thousands of miles from the world's news and all sources of supply, and with little local news and a small public. In Tasmania, or, to give it its older name, Van Diemen's Land, an even smaller settlement struggled with most primitive conditions: a little community housed for the most part in bark huts, the poorer settlers clothed at times in skins when stores of clothing ran short, and new supplies were long in coming, living in constant dread of a descent of hostile blacks, or, later, of bushrangers, such circumstances offered few hopes of success to a paper. The earlier "Gazettes," "published by authority," had one source of support as the vehicle of Government proclamations and announcements at a time when "the words, the habits, the conduct, and almost the looks of the people were regulated by general orders," a newspaper thus becoming a necessity. But this did not last long, and a general unwillingness to pay subscriptions even in kind, must have seriously discounted any advantage. Then in the conduct of the paper itself, not only were facilities for collecting news entirely absent, but the mere distribution presented difficulties hard to realise in a settled country. A notice in Howe's "Sydney Gazette" for February 1st, 1812, shows in a sentence the primitive conditions of life. "To subscribers.—The last week's paper did not leave town till Wednesday, owing to the pacquets which we sent by a messenger on horse-back on Sunday, being run away with by the horse, who left his rider on the Paramatta road, and distributed the paper about the woods of Gommorramorara, from whence they were recovered and, of necessity, reprinted."

Then appliances were apt to be primitive even for the time. A small hand press, probably not new, a miscellaneous assortment of second-hand type—these were the tools with which the early pressmen worked. The printer had need of courage and determination. The type for the "Port Philip Gazette," in 1839, was dumped in an unassorted heap on the floor. It needed cleaning—experiments had to be made with the ashes of different woods in order to discover a ley. A roller was wanted—and had to be made. The idea of a rubber roller occurred to the experimenter, but there was not enough of the material at hand to carry out the idea that anticipated a patent of some years later. At a loss for some large letters, the printer, Mr. Strode, had to cut all over four line letters, finding after many trials that New Zealand pine stood the sun and the water best for his cutting. In the following year he had to face an even greater difficulty, when, owing to the drunkenness and insubordination of his two workmen, "for six weeks he continued single-handed to bring out his bi-weekly issue without dummies and without delay. The first finger was so

inflamed with the picking up of the type that he had to employ the next finger. He allowed himself but two hours sleep each night."

We learn that the "Colonist" boasted a "Columbian press, the largest probably that has ever crossed the line." In 1865 there is a notice of the marvels of the new printing press of the London "Times," a Koenig, "turning out 1,000 sheets an hour." Many another press has crossed the line since then and the printer's craft has been revolutionised and the principal Australian journals have not been slow in adopting the latest developments, what Americans are pleased to call "Back numbers," being removed as scrap-iron to make place for newer models. From the small hand-press of Howe's time and the restricted and variegated paper supply that so often vexed his soul, to a present day newspaper-office with two or three of Hoe and Co.'s huge printing and insetting machines capable of turning out a 10 to 24-page paper at a rate of from 24,000 to 72,000 an hour, using rolls of paper from 3 to 5 miles long, is a far cry. In most of the larger offices linotypes have entirely superseded hand-setting, and electricity displaced steam as a motive power. As time has passed the names of newspapers have grown shorter, and their prices have decreased, while on the other hand circulations have increased from the old "Gazette" 350, and the boasted unprecedented edition of the old "Australian" in 1825—682, and the 1,000 on which the "Monitor" paid stamp duty, to figures in some cases equalling all but a few of the most widely distributed English journals.

The capital of each State has as a rule its two great dailies, most offices publishing also weekly and some evening papers, the latter freely and well illustrated. In Sydney the "Sydney Morning Herald" and the "Sydney Mail," the latter an illustrated weekly with its own staff of artists, photographers and photo-engravers, uphold the traditions of the firm, the "Bulletin," that "journalistic sledge hammer," blends aggressive democracy with the encouragement of local literary talent of the swag, hilly and back-blocks type. The "Town and Country Journal," devoted to pastoral, agricultural and mining boasts a large number of readers; the "Pastoralists' Review" is a monthly journal devoted to matters affecting the pastoral and agricultural interests; the "Stock and Station Journal," devoted to producers, is a bi-weekly, while the "Worker" is the official organ of trades unions. Of provincial prints, the "Forbes Times" (1861) claims to be the oldest paper in the western districts of New South Wales, the "Glen Innis Guardian" (1871), the oldest of northern New South Wales, while the "Tenterfield Standard" (1870) claims seniority of twenty years in the agricultural and mining districts towards the Queensland border. In Victoria, the "Argus" and the "Australasian," the "Age" and the "Leader" hold their own, while dozens of others represent every shade of opinion and every interest, and not a few nationalities, including German, Jewish, and Chinese. The same may be said of the other States and capitals. In Adelaide, besides the "Register," with its weekly "Observer" and daily "Evening Journal," and the "Advertiser," with its "Chronicle" and "Express," there is "The Critic," an up-to-date weekly, which has contrived to combine the functions of a society and mining journal in a way to win success; and other papers—religious and otherwise. A powerful and widespread country press is a feature of Australian journalism, but this is too wide a subject to be treated in a small space.

*INDUSTRIAL INVESTIGATION AND RESEARCH.**

There are many problems of the highest importance in physics, engineering, chemistry, geology, and the arts, of which the investigation might probably prove of great benefit to the human race, and of which the probable monetary cost of the attack would be considerable, and of some very great indeed. Let us, then, inquire how the necessary funds could be raised. It is possible in the case of some of the more attractive problems that a group of rich philanthropists might be found, but in most cases it would be impossible to form a company on business lines, under the existing laws of this and other countries, as I shall endeavour to show.

In the case of many of the problems, no patents will give adequate protection; in some cases there is no subject-matter of novelty and importance involved. In other cases the probable duration of the investigation is so long that any initial patents would have expired before a commercial result was reached, and under either of these circumstances there would be no inducement to business men or financiers to undertake the risk.

As an illustration of my meaning, I will take two investigations that have doubtless occurred to the minds of most of those present, though many others of greater or less importance might be cited. One is the thorough investigation of the problem of aerial navigation, with or without the assistance of flotation by gas. This problem could undoubtedly be successfully solved by an organised attack of skilled and properly trained engineers, and the expenditure of a large sum of money. Assuming the problem solved, and commercially successful, it appears to be impossible under the existing patent laws to secure any adequate monopoly so as to justify the expectation of a reasonable return on the capital expended on the invention. For in view of the multitude of suggestions that have been carried out, the practical solution of the problem would appear to rest on a judicious selection of old ideas by means of exhaustive experiments.

Another and perhaps more important investigation which has not, as yet, been attacked to any material

* Extracted from the Address to the Engineering Section of the British Association at Cambridge, by the Hon. Charles A. Parsons, M.A., F.R.S., M.Inst.C.E., President of the Section.

extent is the exploration of the lower depths of the earth. At present the deepest shaft is, I believe, at the Cape, of a little over one mile in depth, and the deepest bore-hole is one made in Silesia, by the Austrian Government, of about the same depth. What would be found at greater depths is at present a matter for conjecture, founded on the dip and thickness of strata observed on or near the surface. Much money and many valuable lives have been devoted to exploration of the polar regions, but there can be no comparison between the scientific interest and the possible material results of such exploration and the one I have chosen for illustration of the inadequate protection afforded by law—namely, a great engineering attack on a problem of geology.

I would ask you to consider the commercial aspect of this engineering geological enterprise, as compared with exploration into new or unknown areas on the surface of the earth.

An exploring expedition into a new country has before it generally the probability of the acquisition of territorial and mineral rights or possessions bringing material gain to the undertakers. The rights of such enterprises are well known, and capital can be obtained with or without national support, as the case may be. On the other hand, the explorer into the depths of the earth has no rights or monopolies beyond the mineral rights of the land he has purchased over his boring; further, it is improbable that he can obtain any patent of substantial value for his methods of boring to great depths. To succeed in the undertaking a great expenditure of money must be incurred, an expenditure far greater than that of an exploring expedition, and analogous to that of a military expedition or a small invading army, and to raise this sum the pioneers have practically no security to offer. For if they succeed in finding rich deposits of precious minerals in greater abundance, or succeed in making some geological discovery associated with deep borings, they gain no exclusive title to these under existing laws. Any other person or syndicate acting upon the experience gained, could sink other shafts in other places or countries, and, benefiting by the experience gained by the pioneers, could probably carry out the work more advantageously, and thus depreciate the first undertaking or render it valueless, as has often occurred before.

Let us consider more closely some of the essential features of sinking a shaft to a great depth, for I think it will be seen that it presents no unsurmountable difficulties beyond those incidental to an enterprise of considerable magnitude involving the ordinary methods adopted by mining engineers. That there would be some departures from ordinary practice on account of the great depth it is true, but these are more of the character of detail. On the design of this boring I have consulted Mr. John Bell Simpson, the eminent authority on mining in the North of England. The shaft would be sunk in a locality to avoid as far as possible water-bearing strata and the necessity of pumping. It would be of a size usual in ordinary mines or coal-pits. The exact position of such shaft would require some consideration as to whether it should commence in the primary or secondary strata. It would be sunk in stages, each of about half a mile in depth, and at each stage there would be placed the hauling and other machinery, to be worked electrically, for dealing with each stage. The depth of each stage would be restricted to half a mile in order to avoid a disproportionate cost in the hauling machinery and the weight of rope, as well as increased cost in the cooling arrangements arising from excessive hydraulic pressures. At each second or third mile in depth there would be air-locks to prevent the air-pressure from becoming excessive owing to the weight of the superincumbent air, which at from two to three miles would reach about double the atmospheric pressure at the surface. A greater rise of pressure than this would be objectionable for two reasons—firstly, from the inconvenience to the workmen; secondly, from the rise of temperature due to the adiabatic compression of the circulating air for ventilating purposes. The air-pressure immediately above each air-lock would thus reach to about two atmospheres, and beneath to one atmosphere. In order to carry on the transfer of air through the air-locks for ventilating purposes pumps coupled to air-engines would be provided, the energy to work the pumps being obtained from electromotors. To maintain the shaft at a reasonable temperature at the greater depth powerful means of carrying the heat to the surface would be provided.

The most suitable arrangement for cooling would probably consist of large steel pipes, an upcast and a downcast pipe, connected at the top and bottom of each half-mile section in a closed ring. This ring would be filled with brine, which by natural circulation would form a powerful carrier of heat; but the circulation, assisted by electrically driven centrifugal pumps, would be capable of carrying an enormous quantity of heat upwards to the surface. At each half-mile stage there would be a transfer of the heat from the ring below to the ring above by means of an apparatus similar in construction to a feed-water heater, or to a regenerator constructed of small steel tubes, through which the brine above would circulate, and around the outside the brine in the ring below could also circulate, the heat being transmitted through the metal of the tubes from brine ring to brine ring.

We have now presented to us two alternative arrangements for cooling. One arrangement would be to cool the brine to a very low temperature in the top ring at the mouth of the shaft by refrigerating machinery, so as to provide a sufficient gradation of temperature in the whole brine system, to ensure the necessary flow of heat upwards from brine ring to brine ring, and overcome all the resistances of heat-transfer, and so maintain the lowest ring at the temperature necessary for effectual cooling of the lowest section of the shaft. But a better arrangement would be to place powerful refrigerating

machinery at certain of the lower stages, the function of this machinery being to extract heat from the ring below and deliver it to the ring above. This latter method would increase to a very great extent the heat-carrying power of the system, which in the first arrangement is limited by the freezing temperature of brine in the descending column and the highest temperature admissible in the ascending brine column. The amount of heat conducted inwards through the rock-wall and requiring to be absorbed and transferred to the surface depends on the temperature and conductibility of the strata. But there is no doubt that the methods I have indicated would be capable of maintaining a moderate temperature in the shaft to depths of twelve miles.

During the process of sinking at the greater depths the shaft bottom would require the application of a special cooling process in advance of the sinkers, similar to the Belgian freezing system of M. Poesche used for sinking through water-bearing strata and quicksands, and now in general use. It consists in driving a number of bore-holes in a circle outside the perimeter of the shaft to be sunk; through these bore-holes very cold brine is circulated, thus freezing the rocks and quicksands and the water therein, and when this process is completed the sinking of the shaft is easily accomplished.

In our case this process would be maintained not only on the shaft bottom, but also for some time on the newly-pierced shaft sides, until the surrounding rock had been cooled for some distance from the face.

As to the cost, rate of boring, and normal temperature of the rock, an approximate estimate has been made, based on the experienced gained on the Rand, but including the extra costs for air-locks and cooling:—

Depth from the surface.	Cost. £	Time in Years.	Temperature of Rock.
For 2 miles..	500,000	10	122° F.
,, 4 ,, ..	1,100,000	25	152°
,, 6 ,, ..	1,800,000	40	182°
,, 8 ,, ..	2,700,000	55	212°
,, 10 ,, ..	3,700,000	70	242°
,, 12 ,, ..	5,000,000	85	272°

I hope I have succeeded in showing in the short time at our disposal that an exploration to great depths is not an impossible undertaking. But my object in discussing the enterprise at some length has been to show that a pioneer company would not acquire any subsequent monopoly of similar works under the existing patent laws or the laws of any country.

In the scheme as I have described it, there appears to be nothing that could be patented; but let us suppose that some good patent could have been found that was absolutely essential to the success of the undertaking, it would certainly have expired before the pioneer company could have reaped any substantial return, and probably before the first enterprise had been completed. It follows, therefore, that at the present time there is no adequate protection or indeed any protection at all, for the promoters of many great and important pioneer enterprises, some of which might prove of immense benefit to mankind.

ALCOHOL FOR INDUSTRIAL PURPOSES.

The Chancellor of the Exchequer has appointed the following to serve as members of a Committee to inquire into the use of duty-free alcohol for industrial purposes:—Sir Henry Primrose, K.C.B., C.S.I. (Chairman), Professor Sir William Crookes, F.R.S., Sir W. H. Holland, M.P., the Hon. J. Scott Montague, M.P., Mr. Lothian D. Nicholson, Dr. W. Somerville, Dr. T. E. Thorpe, C.B., F.R.S., Mr. Thomas Tyrer.

The terms of reference are:—"To inquire into the existing facilities for the use without payment of duty of spirits in arts and manufactures, and in particular into the operation of Section 8 of the Finance Act, 1902; and to report whether the powers conferred upon the Commissioners of Inland Revenue by this section permit of adequate facilities being given for the use of spirits in manufactures and in the production of motive power, or whether further facilities are required; and if it should appear to the Committee that the present facilities are inadequate, to advise that further measures could be adopted without prejudice to the safety of the revenue derived from spirits, and with due regard to the interests of the producers of spirits in the United Kingdom."

The need of duty-free spirit for industrial purposes was strongly urged by Mr. Tyrer in the paper which he read before the Society of Arts, April 27th last (see *ante*, p. 503).

General Notes.

VENICE ART EXHIBITION, 1905.—The Municipal Council of the City of Venice announce for the year 1905 their Sixth International Art Exhibition, which will be opened on the 22nd April and closed on the 31st October. It will contain pictures, sculpture, drawings, engravings, and objects of decorative art. The Exhibition is divided into Italian, Foreign and International Rooms. Works already shown in Italy will not be accepted at the Exhibition of Venice. Except in the case of individual shows and in certain other cases to be left entirely to the judgment of the respective committee, no artist is allowed to exhibit more than two works of the same kind. Articles intended for exhibition must be notified not later than January 1st, 1905. The notification must be sent in duplicate, using the schedule issued for that purpose by the secretary. Goods must be consigned at the buildings of the Exhibition (*Giardini Pubblici*) not before the 10th of March and not later than the 25th of March. All communications should be addressed to the Office of the Secretary of the Exhibition (*Municipio di Venezia*).

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FRIDAY, SEPTEMBER 16, 1904.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

EXAMINATIONS.

The Programme for 1905 is now ready, and can be had, price 3d., on application to the Secretary, Society of Arts, Adelphi, London, W.C.

The Examinations will commence on Monday, April 10th, 1905.

Proceedings of the Society.

CANTOR LECTURE.

OILS AND FATS—THEIR USES AND APPLICATIONS.

By Dr. J. Lewkowitsch, M.A., F.I.C.

Lecture I.—Delivered January 25th, 1904.

In its widest sense, our subject embraces not only those familiar products, oils and fats, or the products derived therefrom, with which everyone is acquainted, such as candles, soap, and glycerin, but it also includes some branches of the agricultural industries. For not only the cultivation of oleaginous seeds and the growing of oil-yielding fruits, but also the raising of fat stock fall within the purview of the industries which will occupy our attention in this lecture and the following ones.

Thus the oil and fat industries play a very important part in the domestic economy of our daily life, especially if we include amongst them, as indeed we must, the industry of edible oils and fats.

I do not intend to treat the subject from a historical point of view, and I will therefore plunge straightway into the present state of the industry. From the figures which will be found in the tables on the following pages it will be gathered that the industries with which I am dealing here belong to a branch of chemical industry which has found some of its highest developments in this country, and can favourably compare both in extent and scientific importance with that of any other country.

In order to give an approximate idea of the enormous sums that change hands in these industries in this country alone, I have compiled from the Board of Trade returns the figures contained in the following four tables (pp. 796, 797).

Sources of Supply.

Fatty oils and fats occur in every part of the vegetable and animal organisms. They accumulate, however, in certain parts of the plant or animal in greater quantities than in others. In plants, they are generally contained in some considerable quantities in the fruits or seeds, so that their extraction becomes commercially feasible.

We are able to produce fatty oils and fats synthetically from fatty acids and glycerin, and it may become possible in the distant future to manufacture the fatty acids themselves from petroleum hydrocarbons. Nature, however, has so bountifully supplied us with the raw material, that the production of oils and fats by synthetical methods will for a long time to come lie outside the domain of practical considerations.

As the supply of home grown oleaginous seeds is altogether a negligible one, and furthermore, as the quantities of home produced fats such as lard, tallow, butter, play an insignificant part as compared with the total quantities that are brought into the market, foreign sources of supply forced themselves at an early stage of our industries on the attention of the manufacturer.

Owing to the geographical position of this country, it is no wonder that the earliest works which were erected inland, rapidly migrated to the seaports of London, Liverpool, Hull, Bristol, Glasgow, and Leith. These towns thus became the great emporia of the fat and oil trade in this country. Here we receive the enormous quantities of oleaginous seeds: the linseed from India, from the Argentine, from Russia, and from Canada, to be converted into linseed oil for the soap and paint and allied industries, and into linseed cake for our cattle-raising counties. Here is landed the cotton seed that flows into this country

TABLE I.—IMPORTS.

	1898.	1899.	1900.	1901.	1902.
	£	£	£	£	£
Butter	15,961,783	17,213,516	17,450,435	19,297,396	20,526,690
Margarine	2,384,381	2,549,476	2,464 825	2,556,679	2,569,503
Cacao Butter	29,559	28,461	80,162	40,792	10,948
Oleomargarine	257,595	263,435	300,253	298,810	292,988
Lard	2,887,801	3,068,975	3.266,582	4,037,689	4,118,992
Imitation Lard	89,025	90,010	98,629	154,239	284,830
Oils—					
Fish, Train or Blubber	323,194	332,703	389,712	453,809	473,218
Sperm	26,154	14,293			
Animal	62,704	74,531	117,131	120,427	93,438
Castor	172,091	156,571	78,847	155,581	160,421
Cocoanut	344,108	545,642	667,204	594,154	719,357
Olive	608,122	553,286	461,084	581,893	657,956
Palm	975,427	1,037,265	1,086,555	1,370,645	1,679,610
Seed	689,934	879,171	1,038,564	1,193,577	913,642
Oil Cake—					
Linseed	1,465,730	1,589,802	1,395,916	1,272,144	1,255,066
Cottonseed	765,799	987,445	1,051,528	1,036,309	1,103,881
Other sorts	52,715	71,997	100,097	105,193	113,991
Seeds—					
Cotton	2,069,111	2,036,550	2,624,450	2,705,597	3,285,650
Linseed	2,920,634	3,383,962	4,162,146	4,263,931	4,486,997
Rape	367,736	307,053	246,620	298,426	385,708
Other Seeds	339,609	355,352	387,138	546,132	539,159
Tallow and Stearine	2,066,433	2,380,033	2,835,217	2,333,246	2,708,717
Candles	27,740	21,822	23,182	21,347	17,921
Soap and Soap Powder	..	..	244,345	315,026	428,850
Soap (transparent)	774	604	511	538	450
Linoleum	..	..	119,661	73,482	70,946
Varnish	45,655	47,001	56,397	47,637	54,213
	33,973,814	37,689,116	40,929,185	43,874,659	46,953,142

TABLE II.—EXPORTS.

	1898.	1899.	1900.	1901.	1902.
	£	£	£	£	£
Butter	59,731	53,195	55,792	59,376	79,130
Margarine and all artificial Butters	16,434	7,586	7,111	10,057	11,347
Oleomargarine	21,954	26,874	16,803	16,857	31,283
Oils:—					
Linseed	377,307	476,110	588,866	661,448	655,082
Cottonseed	323,191	217,890	428,404	386,407	660,695
Other Seed Oils	67,645	64,657	98,014	109,813	114,116
Oil Cake	?	?	200,336*	237,162*	145,523
Grease, Tallow, and Animal Fats	759,516	850,892	758,563	820,778	778,336
Candles†	329,167	412,181	398,138	432,714	433,549
Soap	829,610	941,575	939,510	999,524	1,126,102
Oil and Floorcloth	1,000,447	1,164,267	1,312,833	1,298,007	1,465,845
	3,785,002	4,215,227	4,804,370	5,032,143	5,501,008

* These figures include sweetened food.

† Contain paraffin.

TABLE III.—RE-EXPORTS.

	1898.	1899.	1900.	1901.	1902.
	£	£	£	£	£
Butter	319,806	257,999	258,934	254,746	227,576
Margarine and all artificial Butters	24,721	33,319	27,882	35,937	46,249
Cacao Butter	5,645	276	792	1,072	926
Oleomargarine	56,410	53,076	87,834	83,438	60,566
Lard	674,828	810,903	480,797	551,512	155,457
Imitation Lard	11,875	4,332	2,276	1,453	6,548
Oils—					
Fish, Train, Blubber, Sperm	30,426	24,726	33,335	34,844	33,865
Animal	14,127	9,024	5,743	4,945	3,388
Castor	21,529	17,474	16,995	16,733	16,586
Cocoanut	80,337	134,402	176,952	201,986	219,183
Olive	124,728	154,773	81,110	109,915	143,759
Palm	623,664	657,796	721,397	762,427	866,163
Seed	83,746	59,361	59,119	74,566	77,254
Oil Cake—					
Linseed	3,582	1,713	1,649	595	1,092
Cotton seed	104	169	174	1,240	281
Other sorts	26,695	23,147	22,497	18,584	16,753
Seeds—					
Cotton	329	1,909	6,212	779	2,468
Linseed	245,597	166,586	343,031	410,694	396,044
Rape	44,326	48,040	45,581	31,783	70,279
Other sorts	220,892	189,766	211,989	324,677	303,656
Tallow and Stearine	1,065,143	1,165,687	1,232,649	324,677	303,656
Candles	13,711	9,759	15,982	14,082	6,752
Soap and Soap Powder	..	..	18,434	17,194	18,683
Soap (transparent)	234	87	45	63	54
Floorcloth	..	..	7,308	6,848	6,239
Varnish*	1,363	2,739	2,415	462	1,115
	3,693,828	3,827,063	3,861,132	3,285,252	2,984,592

* Most of Varnishes are includ d under "Pain's."

TABLE IV.—SUMMARY.

	1898.	1899.	1900.	1901.	1902.
	£	£	£	£	£
Imports	33,973,814	37,689,116	40,929,185	43,874,659	46,953,142
Exports	3,785,002	4,215,227	4,804,370	5,032,143	5,501,008
	37,758,816	41,904,343	45,733,355	48,906,802	52,454,150
Less re-exports	3,693,828	3,827,063	3,861,132	3,285,252	2,984,592
	34,064,988	38,077,280	41,872,223	45,621,550	49,469,558
Add home products—					
Butter (estimated)	..	..	3,500,000	..	3,850,000
Lard (estimated)	..	..	1,000,000	..	1,100,000
Tallow (estimated)	..	..	3,000,000	..	3,300,000
	..	..	49,372,223	..	57,719,558

from Egypt, and more recently from Bombay and the Levant, to yield edible cotton seed oil, soapmaking oil, and cotton seed cake. Here also is imported the rape seed from India, the castor seed, and in smaller quantities some other seeds, that have helped to create the vast seed-crushing industry which has reached, through the inventions of two Englishmen, Bramah and Armstrong, a completeness of mechanical detail which has maintained the supremacy of our country in this industry.

Enormous as are the quantities that are thus imported and worked up in this country, still they represent only a small quantity of the oleaginous seeds that nature offers us. Thus, India, China, and Japan possess vast stores of seeds, yielding safflower oil, bean oil, tung oil (Japanese or Chinese wood oil), and other oils, which are awaiting industrial application. All that appears to be required is better communication to stimulate the cultivation of oleaginous seeds.

Vaster still are the stores of hard vegetable fats which tropical countries such as India, the Sunda Islands, South America, and tropical Africa are able to furnish. Hitherto only two or three kinds of vegetable fats have found extensive use in this country, namely, cocoanut oil and the two oils obtained from the palm tree—palm oil and palm kernel oil. Smaller quantities only of other fats, such as Mowrah seed oil and Mahwah butter, reach this country, whereas the Continent of Europe seems to be less conservative in the choice of its raw materials. Thus, Chinese vegetable tallow and shea butter are chiefly worked up in Marseilles and in the North of Europe, whereas only comparatively small quantities reach this country. The vast stores which the Malayan Archipelago alone could furnish seem to be practically unknown to the majority of manufacturers.

This is not the place to examine whether this feature is due to the want of communication in India, or to the want of enterprise and the indolence of the natives. In the case of palm oil, at least, which could certainly be employed in much larger quantities, it is owing to the deadly climate and to the laziness of the negro that one of the most admirable raw materials of our staple industries cannot be obtained at a price which should be much lower than that at which it is supplied at present.

Nor does it appear that those who are most interested in the shipping trade of the West Coast of Africa take such steps as are required to foster this industry. We would do well to imitate the example of Germany who, since she entered into the possession of colonies on the West Coast of Africa, has taken the most energetic interest in promoting the cultivation of the palm tree, which yields one of the chief exports of the Guinea Coast. We may confidently expect that our Imperial Institute will, like similar institutions in France, Germany, and Holland, help in arousing the interest of the manufacturer, and place before him the treasures that are still lying unused in our Colonies.

[Here a large collection of oil and fat-yielding seeds was shown. Most of the Indian specimens had been contributed by the Imperial Institute through the kindness of Prof. Dunstan.]

With respect to the marine animal oils, it is but natural that they should be produced in this country on a very extensive scale. The industry of medicinal cod oil is naturally small in extent, whereas the industry of commercial cod oil and fish oils has received an enormous impetus during recent years, through the replacement of the old sailing craft, which had to keep out at sea for some days before a sufficient amount of livers were collected, by fast steamers which bring in their nettings within one day.

Thus we obtain large quantities of oil; and yet these do not seem to suffice, for very considerable quantities of cod oil are imported from Newfoundland, as also fish oil from Japan. The large representative collection of seal, whale, and allied oils which I place before you will give an idea as to the extent this branch of the oil industry occupies in this country.

Turning to the solid fats of the animal kingdom, the production of lard, of tallow, and of butter in this country is but an insignificant one as compared with the quantities we import. The changes in the source of supply that have occurred during the last 20 years do not appear to be well-known. The name of "Petersburg yellow candle tallow," once a household word with the tallow chandler and soapmaker, has passed into the limbo of things that were. Russia, instead of exporting tallow, has become a large importer of Australian tallow. Up till a few years ago, the United States of America have been supplying this market with a large amount of its requirements; but it seems as if America will in a few years drop out of the rank of those countries which can spare any supplies for us.

Australia and New Zealand, in conjunction with the Argentine, are now our chief sources of supply of this indispensable raw material for our industries. The high prices that were the result of the long-lasting drought in Australia are bound to stimulate an increased production, and it may be hoped that under the beneficent rule that has recently gained its predominance in South Africa, the Transvaal and Orange Colony will become great cattle-raising centres.

Owing to the large consumption of meat in this country, the amount of "home tallow" (home-rendered tallow) is very considerable. It seems, however, impossible to state even approximately the amount so produced, as the most experienced dealers are at a loss to know at what figure to place the home production.

From the first table given above may be gathered the enormous amount of butter that is imported into this country. Not only are Holland, Denmark, and Sweden competitors in this market, but even Siberia and Australia have entered the lists, and it must be expected that, under the stimulus of the expanding consumption, improvements in cold storage methods will permit the products of the Antipodes to reach us in the same state of freshness as they arrive from neighbouring countries.

A few words only can be said about lard. It is well known that our chief supplies come from the United States, where as many as 10,000 hogs are killed per day in some of the enormous packing houses, and worked up on the same day into all the products that can be obtained from them. Owing to the desire on the part of the manufacturer to produce the largest possible quantity of lard, the word "lard" has ceased to have its old meaning, *i.e.*, "fat from the leaf," and in the majority of cases it must be understood to mean the fat that is derived from any part or all parts of the hog.

The methods of producing fatty oils date back to the remotest times in the history of mankind. It is therefore obvious that the technical appliances used even at the present day range from the simplest contrivances constructed by the natives of Asia and Africa up to the most elaborate machinery employed in this country.

Time does not permit me to present here the development of this industry from the early dawn of civilisation, and I must content myself with contrasting by means of a few slides (shown on the screen) the present-day manufacture of palm oil in West Africa and the Philippines, and of the Chinese bean oil in Manchuria, with the methods in vogue in this country.

The modern processes divide themselves naturally into two classes,

I. Recovery of oils by expression.

II. Recovery of oils by extraction with volatile solvents.

Common to both processes is the machinery required for the preliminary treatment of the fruit or seeds.

1.—Recovery of Oils by Expression.

The recovery of oils by expression has reached the very complete system in vogue nowadays in the best equipped establishments through the invention of the hydraulic press and the accumulator, to which reference has been made already.

Since the machinery required for the preliminary treatment of the fruit or seeds must vary with each particular kind of fruit or seed, the preparatory operations for laying bare the fat-containing cells of, *e.g.*, cocoanuts, will naturally differ from those necessary in the case of linseed. I will therefore illustrate, by means of a series of lantern slides, the preliminary treatment of a few kinds of fruits and seeds, such as palm kernels, copra (dried cocoanut kernels), arachis nuts, castor seeds, cotton seed, linseed, and safflower seed.

[The following lantern slides were shown:—Screen and magnetic separator for palm kernels and copra; palm kernel and copra breaking mills, breaking rollers for copra, arachis nut decorticator, separator for decorticated arachis nuts, decorticator for castor seed, cotton seed delinting machine, cotton seed decorticators (different types; American and English machines), linseed screen, and plants illustrating the working of the various machines described. Samples of the different seeds and various kinds thereof (especially various kinds of linseed and cotton seed) were also shown.]

The immense quantities in which smaller seeds such as cotton seed or linseed are crushed, necessitated the construction of special warehouses or silos, where the seeds are stored in a similar manner as grain is warehoused, the seed being frequently turned so as not to heat spontaneously, since heating acts detrimentally on the quality of the oil.

The seed entering the oil mill from the silos is reduced to "meal" on passing through crushing machinery of the kind I show in the lantern slide representing the Anglo-American five-roller machine. The comminuted seed is either expressed in this state

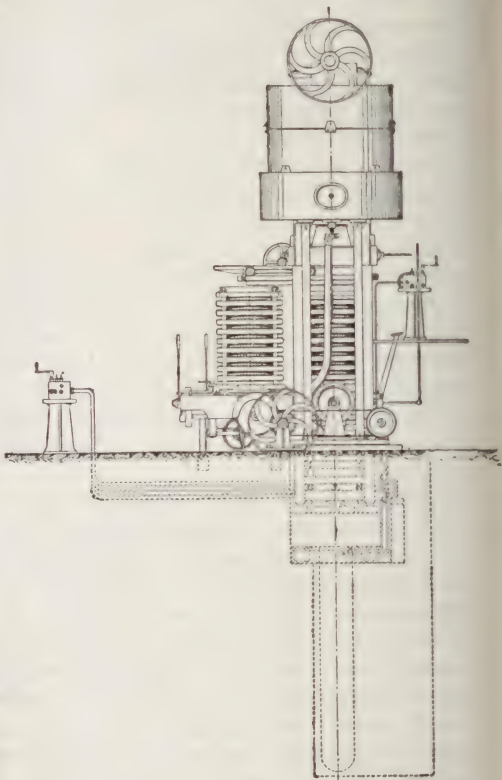
(production of oils for edible purposes) or conveyed by means of an elevator into a kettle in which the seed is warmed (production of oils for manufacturing purposes) by means of steam, which causes the cells to burst rapidly, renders the oil more fluid, and perhaps also helps to coagulate some albuminoid matter, all these operations combining to facilitate the subsequent moulding of the meal into cakes.

An exactly-measured quantity of heated seed then falls out, on opening a slide, and drops into a measuring-box. On being drawn forward, this allows the seed to fall on to a press-cloth of the desired shape of the oil-cake. By a preliminary pressing sufficient consistence is given to the cake so that it can be carried, wrapped in the cloth, to the hydraulic press. This consists, in the Anglo-American system of seed-crushing, of an open press, fitted with about 16 iron press plates, between which the cakes are inserted by workmen. The press is packed with cakes until full; the ram is then driven up by machinery, at first with the help of an accumulator, and finally by hydraulic pumps. The oil exudes from the meal, drains off, and is collected in tanks below the press or set of presses which are generally arranged in the Anglo-American system in a battery of four presses. After releasing the pressure the cakes are taken out, and the edges, which are soft and oily, are trimmed off in a cake-paring machine. Obviously, the cakes retain a certain quantity of oil, and in the case of those seeds which contain a large amount of oil, such as castor seed, a second expression is required.

The hard cakes are, therefore, broken up in a cake-breaking machine, whilst the softer cake-parings are triturated in a special machine. In some cases an edge-runner mill is used for the same purpose. (All the machines mentioned, as also an *ensemble* of an oil mill plant, were shown in lantern slides.)

The first expression of seeds that are rich in oil, such as those containing more than 40 per cent., leads to some difficulties in the open hydraulic press, since the oily meal causes "spueing," *i.e.*, the soft mass is apt to exude through the cloth. Hence, in modern installations, seeds of this kind are frequently expressed in a "clodding press," *i.e.* a hydraulic press provided with a circular box or cage into which the material is filled. The box is either constructed of metal staves (vertical steel bars), held together by a number of steel rings, or consists of a cylinder having a large number of perforations. These presses, generally worked in sets of two, or three, or more, have a seed kettle fixed on the top of the press (see Figs. 1, 2); the kettle is provided with an opening or openings, corresponding to the chamber or chambers in the heads of the press or presses. These chambers can be closed at the top and bottom by slides, actuated by levers, and are designed to contain so much meal as is required to form one cake. The measured charge of meal is then

FIG. 1.



allowed to fall into the press box, and covered with a circular metal plate. This operation is repeated until the press is full, when hydraulic pressure is applied, and a ram forces the box against the sliding block at the head of the press. The oil exudes, and the meal, pressed into circular cakes, is ready for the second expression. After releasing the pressure and removing the sliding block, the cakes are forced out by the hydraulic ram. They are then broken into meal, and subjected to a second expression in the Anglo-American hydraulic press, described already.

Modern improvements in the mechanical part of the process dispense even for the

FIG. 2.

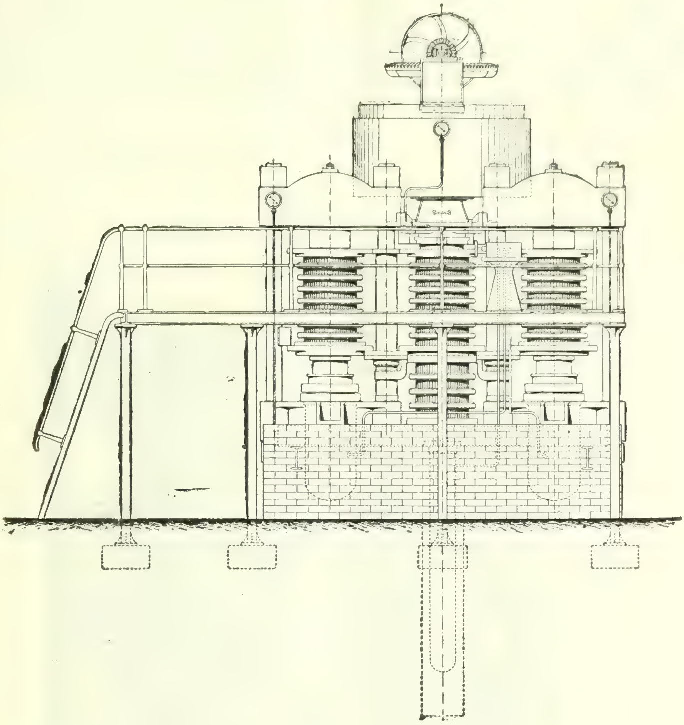
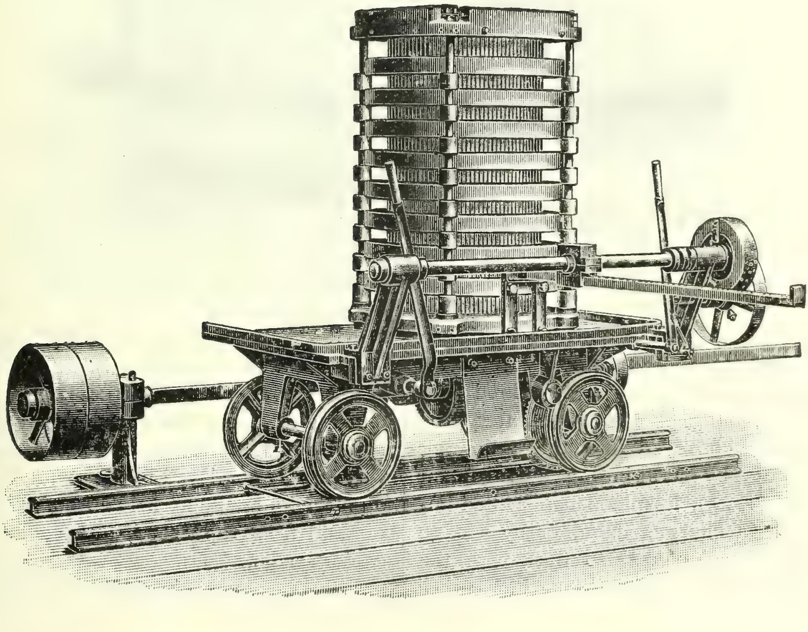
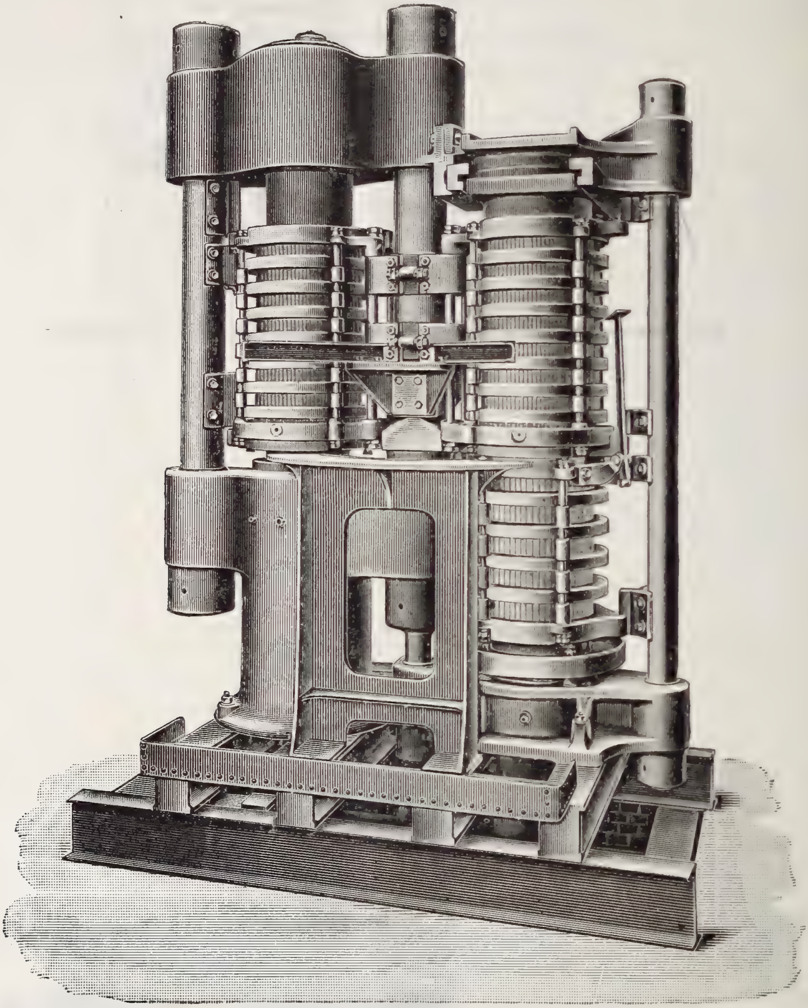


FIG. 3.



second expression with the open Anglo-American press. The finishing presses are of the same type as the press in which the first expression is carried out, and by making the press cages removable, the pressing operation can be made a practically continuous one. These press cages can either be transported by means of a power-driven carriage (Fig. 3) to the finishing presses, or if one preliminary press is combined with one or two finishing presses to a battery, the cages can be conveyed into the adjoining finishing press by a swinging arrangement (Fig. 4, and Fig. 5), its place being filled immediately by a charged cage, or by a cage containing finished cakes, so that, with the exception of the time required for withdrawing the pressing cages and replacing them, the work goes on continuously. Further advantages are offered by these presses, in that the cakes require no paring, and that great saving of press cloths is effected in comparison with the open plate process of the Anglo-American system.

FIG. 4.



2.—RECOVERY OF THE OILS BY EXTRACTION WITH VOLATILE SOLVENTS.

The second class of processes for obtaining oils and fats from fruits or seeds is represented by the so-called "extracting processes," and is very largely employed in the extraction of olive oil marc and palm kernel oil from palm kernels, rape oil from rape seed, and castor oil from castor seeds.

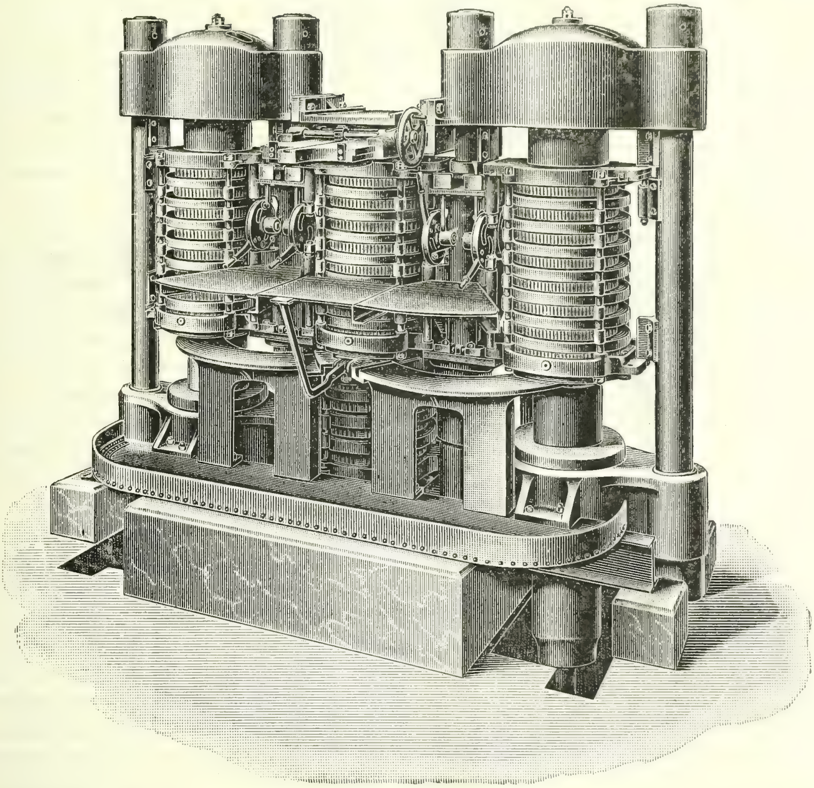
The solvents employed on a large scale are

lmost exclusively petroleum ether and carbon isulphide; ordinary ether must be considered s altogether outside the range of the solvents sed on a large scale owing to the considerable oss of solvent involved, and furthermore on ccount of the great danger of fire. The same langer attaches, although in a somewhat ninor degree, to the employment of petroleum ther. More diminished still is the danger of n inflagration in the case of carbon bisulphide; as this solvent is heavier than water, he vapours are less liable to come in contact with an open flame. Hence, carbon bisulphide is largely employed for the extraction of oil, notably for the extraction of the marc of olives. Still, owing to the physiological effect this solvent has upon the workmen, coupled with the danger caused by the action of impure carbon bisulphide on iron, which has frequently led to conflagrations, the employment of carbon bisulphide is restricted.

An ideal solvent would be carbon tetrachloride, which is non-inflammable, and has the further advantage of being heavier than water. Its high price has, however, hitherto prevented its technical application. Furthermore, its physiological effect (similar to that of chloroform) on the workmen would seem to prevent its general application.

The type of apparatus employed on a large scale depends on the temperature at which the extraction is carried out. In the case of cold extraction (preferable as regards fire insurance), the seed is placed in a series of closed vessels through which the solvent percolates on the counter-current system. The battery of vessels is so arranged that any one vessel can be made the last of the series, ready to discharge the extracted meal, and to be refilled with fresh meal, so that, with the exception of the time required for charging and discharging, the process is practically a continuous one. The solution of extracted oil or fat is then transferred to a steam-heated still, where the solvent is driven off, and recovered by condensing the vapours in a cooling coil. Thus the same quantity of solvent is used over and over again. The last traces of volatile solvent in the oil or fat are driven off by a current of open steam whic

FIG. 5.



is blown through the oil or fat whilst kept hot.

The extracting processes in the hot are carried out in apparatus, the principle of which is illustrated by Fig. 6 (where the condenser is not shown). I further show, in a few lantern slides, several types of apparatus used on the large scale.

The principle involved in more elaborate forms of plant employed on a large scale is exemplified by the well-know Soxhlet extractor. The extraction here takes place continuously, with a limited amount of solvent charged once for all into the apparatus. When the seed is

FIG. 6.

deemed completely exhausted, the vessel containing the seed is disconnected by closing taps between the oil containing vessel and the condenser, so that the volatile solvent can be immediately distilled off and and condensed, whilst the seed-containing vessel is freed from the last traces of volatile solvent by open steam, and emptied and recharged with fresh seed. More compact still are extractors illustrated by that form of laboratory apparatus in which the meal-containing vessel is placed inside the flask charged with the solvent. Thus, in some form of extractors, a basket containing the crushed seed is placed on a support at some height above the bottom of the vessel charged with the solvent, so that, on heating, the vapours of the solvent pass through and round the seed, whilst that portion which leaves the vessel in form of vapour is condensed in a separate condenser, from which the liquefied solvent falls back and percolates the seed. Finally, when the meal is exhausted, the solvent is driven off, and the condensed solvent collected in a separate vessel.

[All these types of apparatus were illustrated by means of lantern slides ; finally a series of slides were exhibited, showing a large rape oil extracting plant.]

In special cases, notably so in the case of olive oil, a combination of the two processes described under the headings 1 and 2 commends itself. The combined method consists in expressing most of the oil in the cold (for edible purposes), and then extracting the partially expressed material with volatile solvents, in order to recover the oil left in the press cakes. This combined process is known on the Continent under the name "huilerie mixte."

Animal oils and fats are usually obtained in a very simple manner by heating those parts of the animals which contain the oil or fat, so as to cause bursting of the fat-containing cells. The older rough and ready methods of heating the adipose tissue over free fire may be considered as almost extinct in this country, but it is still being practised in small establishments on the Continent. The nuisance which follows in the wake of a manufacturing process of this kind has naturally led to stringent regulations on the part of the sanitary authorities.

The rendering of tallow from the "rough fat," as it comes from the slaughterhouses to the rendering establishments is now carried out under such conditions that no serious objections can be raised from a sanitary point of view. The simplest, and as I can testify from my own experience, very effective method for obtaining tallow for technical purposes, is to throw the rough fat into covered lead-lined vessels provided with steam coils, outlet taps, a trap door for charging the rough fat, and a wide outlet through which any offensive vapours that may be given off are conducted through closed pipes to the chimney stack, or boiler, or fire grate. Hot water is then run on to the fat and the steam turned on. After heating for a sufficient length of time the steam is shut off, when the clear melted fat rises to the top. It can then be drawn off ready for use, or into another vessel for further purification (refining, bleaching). The animal tissue, &c., still containing considerable quantities of fat, is boiled

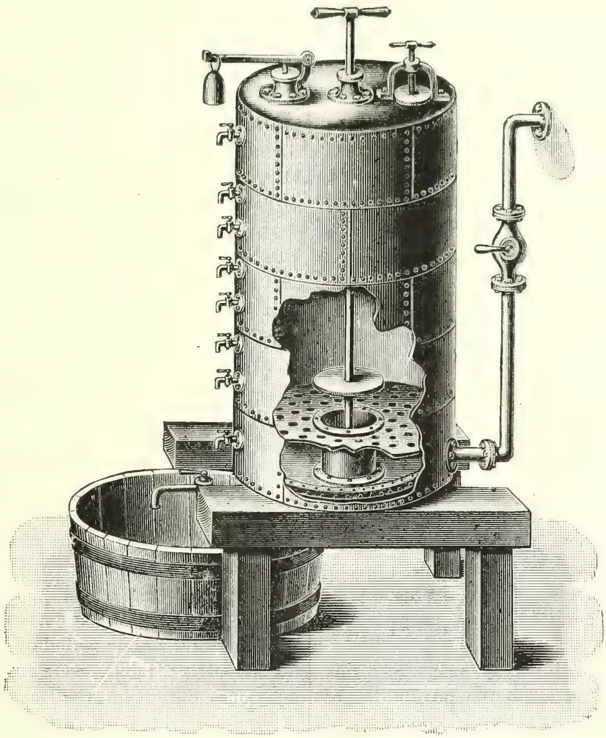
up again with steam, after a few per cent. of dilute sulphuric acid have been added, whereby the cell membranes are "cut," so that they part more readily with the remainder of the occluded fat.

Since in the older method of melting the rough fat over free fire, fat would not infrequently burn on to the sides of the vessel, or even boil over and run into the flue, whereby volumes of the pungent acroleïn were sent into the atmosphere, a number of apparatus have been designed in which the tallow is melted in closed vessels under pressure. Such vessels—termed digesters—consist essentially of a vertical boiler provided with a false perforated bottom, and constructed to withstand a pressure of several atmospheres. Live steam is turned into the boiler below the perforated bottom on which the rough fat rests. At the elevated temperature the mass parts readily with its occluded fat, and in a shorter time than by steaming at the ordinary pressure. The first apparatus of this kind was designed by Wilson (Fig. 7); it has served as a prototype for a number of more or less complicated digesters now in use.

The rendering of lard in the large packing-houses in the United States is carried out on similar lines. More primitive are the methods for obtaining liver and blubber oils.

(The manufacture of the last class of oils was then illustrated by a very complete series of samples, of seal oils, whale oils (No. 0, 1, 2, 3, 4), sperm oils, and bottlenose oils.)

Fig. 7.



Miscellaneous.

MINES AND FORESTS OF BRITISH GUIANA.

The Report of the Council of the Institute of Mines and Forests for the year 1903-4 is dated, Georgetown, 18th July, 1904.

Gold.—In submitting to the Institute the Annual Report required by Ordinance 9 of 1890 to be submitted by the Governor and Court of Policy, the Council have to state that for the year July 1st, 1903, to June 30th, 1904, there has been a noticeable falling off in the export of gold from the colony. Customs returns show that for the year 1902-3 there was exported 101,962 ounces of gold of the value of 1,782,747 dols., while the figures for 1903-4 only stand at 90,734 ounces, of the value of 1,585,434 dols.

Royalty was paid at the Department of Lands and Mines on 101,325 ounces for the year ending June, 1903, while for the same period ending 30th June, 1904, royalty was paid on 87,442 ounces. The reasons for this falling off are not far to seek. Many of the smaller placers, which had been formerly worked systematically, have either been abandoned or been handed over to the rough and ready methods of the "maraudeurs." Local capital has not been forthcoming to any extent, and any influction of outside capital has been directed either to quartz-mining, diamond mining, to the revivication of mining proper, or to hydraulicking. With regard to the latter, it must be remembered that topographical difficulties have had to be overcome by the importation of machinery on a large scale, and that therefore the expected results have not gone to swell the returns of the past year.

When we come to examine in detail the production of the various districts, we find that the Barima district shows a falling off of nearly 3,000 ounces, the Barama of nearly the same amount, and the Cuyuni 3,910 ounces. The Puruni shows a small decrease of 435 ounces; probably this would have been greater had it not been for the working of the Peters' Syndicate, which have not been alluvial in the proper sense of the word, the gold being derived from quartz crushed by hand-power. The Mazaruni shows a decrease of over 1,000 ounces, while the Essequebo alone enjoys the distinction of showing an increase of 571 ounces, due to the workings at Omai, a striking exemplification of the superiority of systematic working. The Potaro shows a decrease of 3,358 ounces, which is only to be compared with that of the Cuyuni, a river which shares with it the reputation of being worked to a great extent by undirected and unsystematic methods.

It is not to be concluded by any means that this falling off is any indication as to the possibilities of the colony, even alluvially, as it is the consensus of opinion amongst experienced and trained mining engineers who have made thorough investigations during the past year that the resources of the country from the point of view of gold are practically untouched, and that the fluctuations in the production of small workings in the creek beds and flats cannot be taken as any indication of the enormous amount of alluvial existing in the spurs and slopes of the hills which ought to give a good return for scientific and up-to-date working for many years to come. It has been stated by a geologist of repute, Dr. Lungwitz, that in one district prospected by him there exists a layer of auriferous gravel extending for some twenty-two miles, and having a width of half a mile and a depth of two to three feet. He estimated that every cubic yard of this gravel carried about 6s. 3d. worth of gold to the ton, and with power existing by which it could be cheaply worked from the neighbouring falls. Professor Harrison, the Government geologist, has also given his opinion that the iron-capped hills of the Essequebo and Potaro districts should prove a source of wealth to the colony for many years to come. Mr. Linck, an experienced mining engineer, says that the alluvial auriferous deposits have so far scarcely been touched. Up to the present, only the beds of the streams carrying only a little water, have been worked by the "pork-knockers" with the crudest of appliances, and in other cases by small syndicates whose appliances for handling dirt are little ahead of the pork-knockers. There is no doubt that in the known gold-fields, the more easily worked creeks have been practically exhausted, thus accounting for the falling off in the gold out-put of the colony. Attention must now be directed to working the auriferous deposits on the slopes of the hills, which, there is no doubt, occur in large areas and only want capital to develop. In many parts of the gold-fields water can be conveyed on to these alluvial deposits by means of ditches, while in others it would be necessary to pump the water to work the ground as is done by the Omai Gold Mining Company, which is working very profitably deposits of gold-bearing wash, that it would be impossible to get water on to otherwise than by pumping machinery. But it is doubtful as to whether many of the claims which are now being systematically worked could not be made to pay should some impetus be given to the outlay of local capital in the direction of affording the small capitalist some assurance that his interests would be safeguarded, and that his gold would not be stolen, his provisions wasted and the labourers induced to desert their employer, lured away by, to them, the superior attractions of "maraudage."

Diamonds.—The export of diamonds for the past year shows a slight increase over that of 1902-3. During the year ended 30th June, 1903, 10,559 carats weight, valued at 96,190 dols., were exported, and during the same period of 1903-4, 11,200 carats, valued at 92,431 dols., were exported. The number of stones declared at the Department of Lands and Mines for the past year was 167,296, weighing 11,303 carats, but it is extremely probable that the shipments for July will be much greater than for any previous month in the year. There have been some suggestions made as to the amalgamation of some of the companies with a view to lessening the cost of transportation and management. The former question, that of transportation, is still a great drawback to the industry, and if some means can be devised of lessening the cost of taking up provisions over the falls of the Mazaruni an undoubtedly great impetus would be given to this growing and important industry. The number of labourers registered for the Mazaruni diamond fields during the year was 1,145.

Forest Products.—The amount of balata exported from the colony during the past year shows 547,601 lbs. as against 490,174 lbs. for the preceding year. Timber showed a slight decrease, 304,881 cubic feet being exported, as against 319,438 cubic feet for the preceding year. Shingles were exported to the value of 94,112 dols., or an increase of 3,988 dols. over 1902-3; firewood to the value of 11,849 dols. as against 2,275

dols.; and gums 11,549 lbs. as against 6,558 for 1902-3. Charcoal, 80,800 bags, to the value of 40,575 dols., were exported, as against 74,383 bags, valued at 58,621 dols., for 1902-3. It would thus appear that the minor forest industries of the colony are capable of considerable expansion, and that a large market exists in the West Indies themselves for charcoal, hardwood and shingles. These industries appear to be almost altogether confined to the Demerara River, and indeed would seem to be the staple industries of that district. It would be interesting to know the number of persons employed in these various industries, which aggregate apparently an export of 342,947 dols., in addition to the value of the timber, shingles, firewood and charcoal retained for home consumption. It would scarcely be going too far to suppose that something like three times the amount exported is consumed in the colony.

Questions of labour, prospecting licences, unregistered labourers, &c., are also discussed in this Report.

*THE TOWN HOUSING QUESTION.**

The fundamental difficulty of the question is the growth of town populations which have been housed without any regard to hygienic conditions.

There are two main aspects of the problem: (1) the sanitary aspect, *i.e.*, the existence of slums and insanitary areas; and (2) the house famine. This, again, is of two kinds: first, and more rarely, a house famine due to special circumstances, *e.g.*, when the sudden growth of an industry causes an abnormal increase of population; second, a constant difficulty as to the supply of cheap houses. Increased cost of building has not checked the growth of superior house accommodation, but has interfered with the production of cheap houses, while improvements remove the old inexpensive cottages. Hence there is great pressure on those which still exist.

How have local authorities attempted to cope with these difficulties?

1. In the case of insanitary areas they have used Part I. of the Housing Act; in the case of small groups of bad houses improvements have been effected by Part II. and by the Public Health Act.

2. The preventive and regulative work of the sanitary authorities has done much, and might do more, to improve bad conditions and to stimulate healthy effort.

3. Lastly, there have been attempts to deal with the house famine by means of municipal house building and owning. There are several different policies with regard to this.

(*a.*) The Liverpool policy of cheap tenement houses on central sites, the object of which is to rehouse the very poorest classes who now occupy court houses. The results are interesting, and there are many arguments for and against it. Various devices have been attempted in order to secure the occupation of municipal houses by the really poor.

(*b.*) Some advocate the plan of building ordinary houses or tenements in large number in order that municipal competition may lower the level of rents. The results of this are slight.

(*c.*) Recently attempts have been made to develop suburban estates. This seems hopeful, but there are many difficulties, especially as to providing for the very poor on such estates.

The main task of house building must be left to private enterprise; the duty of local authorities is to urge private enterprise to do the very best that can be done. There are two main ways of bringing this about: (1) By wise building by-laws properly enforced; (2) by thorough administratiou of the sanitary laws. These two duties are at present very imperfectly performed. The urgent necessity of guarding suburbs and new districts is not yet realised.

Local authorities have experienced great difficulties, especially financial difficulties, as to their building schemes, but recent developments seem more hopeful. Local authorities ought (1) to make experiments, lead, and suggest (examples, Sheffield and Camberwell); (2) in cases of monopoly create competition; (3) where necessary deal with classes which cannot be left to private enterprise, but great caution is essential to the success of such plans.

* Abstract of paper read by Mrs. Fisher before Section F, of the British Association at Cambridge.

*THE ELECTRICAL CONDUCTIVITY OF CERTAIN ALUMINIUM ALLOYS AS AFFECTED BY EXPOSURE TO LONDON ATMOSPHERE.**

This paper deals with the effect upon electrical conductivity of exposing light aluminium alloys to London atmosphere. During three years' exposure the copper-aluminium alloys have gradually diminished total conductivity to a greater extent the greater the percentage of copper. The nickel-copper aluminium alloys, which show such remarkably increased tensile strength as compared with good commercial aluminium, have during the last year considerably diminished total conductivity. On the other hand, the manganese-copper aluminium alloys have suffered comparatively little diminution in total conductivity, and one of them has comparatively high tensile strength. It was thought that an examination of the structure of these alloys by aid of microphotography might throw some light on the great difference which exists between some of their physical properties. For instance, a nickel-copper aluminium alloy has 1·6 time the tensile strength of ordinary commercial aluminium. Under a magnification of

* Abstract of paper by Professor Ernest Wilson, read before Section G of the British Association at Cambridge.

800 diameters practically no structure could be discovered. Considering the remarkable crystalline structure exhibited by ordinary commercial aluminium near the surface of an ingot, when allowed to solidify at an ordinary rate, the want of structure in these alloys must be attributed to the process of drawing down. The inference is that the great difference which exists between their tensile strengths and other qualities is not due to variation in structure. The experiments in micro-photography have been carried out by aid of a portion of the Government grant voted to me by the Council of the Royal Society.

Notes on Books.

SIX LECTURES ON PAINTING, delivered to the Students of the Royal Academy of Arts, January, 1904. By George Clausen, A.R.A., Professor of Painting. London: Elliot Stock.

The author, in considering the present position of the Fine Arts and the adverse circumstances of the times, refers to an anecdote of the condition of painting in the early days of the art which is related by Lanzi. Orcagna, in the first quarter of the fourteenth century, asked the question of his companions, "Who was the greatest master, setting Giotto out of the question?" Some answered Cimabue, some Stephano, some Bernardo, and some Buffalmacco. Taddeo Gaddi said, "Truly these were very able painters, but the art is decaying every day." Mr. Clausen considers this to be comforting and that it shows how the relation of the artist to the world in general was always much the same as it is now. After an introduction on some early painters the subjects of the several chapters are "Lighting and Arrangement," "Colour," "Titian, Velasquez, and Rembrandt," "Landscape and Open-air Painting," concluding with "Realism and Impressionism."

A TEXT-BOOK ON CERAMIC CALCULATIONS, WITH EXAMPLES. By W. Jackson. London: Longman's, Green, and Co.

The author has not attempted to write a text-book on pottery manufacture but to give help to classes in pottery and porcelain by printing a collection of examples showing the application of mathematical and chemical methods to the consideration of the problems presented for solution in the course of the manufacture.

THE ANALYSIS OF OILS AND ALLIED SUBSTANCES. By A. C. Wright, M.A., B.Sc. London: Crosby Lockwood and Son.

The author's intention has been to present an account of the methods used in the analysis of oils, fats, and waxes in a form suited to the needs of the student and beginner, while at the same time including all recent developments likely to be found of value in practical work.

The chemistry of the various processes has therefore been set out in some detail, and methods which have been recently proposed are fully explained. A good deal of space is given to a description of the properties of the more important oils, fats and waxes, with the method for their investigation.

There are also chapters on the physical and chemical properties of oils and fats, as well as on the methods for estimating their constituents.

A RECORD OF THE INTERNATIONAL FIRE EXHIBITION, EARL'S-COURT, LONDON, 1903. By Edwin O. Sachs, Chairman, British Fire Protection Committee. London.

This volume contains a fully illustrated account of the proceedings at this important Exhibition, which was held last year, and a description of the exhibits. Special attention is given to the remarkable Loan Exhibition, in which were shown interesting historical objects relating to Fire Prevention, Fire Protection, Fire Insurance, and Fire Literature, also Portraits and Models, Monuments and Mementoes of Fire Heroes and Worthies, Pictures of Fires, Commemorative Medals, &c. The Collection of English Antiquities was fully supplemented by special foreign exhibits from France, Germany, Holland, Italy, and Russia. The editor claims that the particulars of the collection will serve as an outline of the history of fire extinguishing during the last three centuries, more particularly if studied in connection with the notes of Chief Officer Graham, of Hampton, who was responsible for the correct execution of the Historical Pageant in the Exhibition Theatre.

IMPERIAL INSTITUTE OF THE UNITED KINGDOM, THE COLONIES, AND INDIA. Technical Reports and Scientific Papers. Edited by Wyndham R. Dunstan, M.A., F.R.S. London.

The Reports refer to Coal, Iron Ores, and various Minerals, Fibres, Oils and Oil-Seeds, Rubber and Gutta-Percha, Gums and Resins, Medicinal Plants and Tobacco, Tanning and Dyeing Materials, Fodder Plants and Food Grains, Timber, &c. The scientific papers are devoted to important chemical investigations respecting the technical value of materials sent to the laboratories of the Institute.

THE ELECTRO-PLATING AND ELECTRO-REFINING OF METALS. By Alexander Watt and Arnold Philip, Assoc. R.S.M., B.Sc. London: Crosby Lockwood and Son.

This is a new edition of Alexander Watt's well-known work on "Electro Deposition." The present edition is divided into two parts: Part I. on Electro-Plating, and Part II. on Electro-Metallurgy. Mr. Philip has contributed some two hundred and twenty pages of fresh matter, including chapters on the cost of electrolytic copper refining, and on some important details in electrolytic copper refineries.

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

"OWEN JONES" PRIZE.

This competition was instituted, in 1878, by the Council of the Society of Arts, as trustees of the sum of £400, presented to them by the Committee of the Owen Jones Memorial, being the balance of subscriptions to that fund, upon condition of their expending the interest thereof in prizes to "Students of the Schools of Art who, in annual competition, produce the best designs for Household Furniture, Carpets, Wall-papers and Hangings, Damask, Chintzes, &c., regulated by the principles laid down by Owen Jones." The prizes are awarded on the results of the annual competition of the Board of Education, South Kensington.

Six prizes were offered for competition in the present year, each prize consisting of a bound copy of Owen Jones's "Principles of Design," and a Bronze Medal.

The following is a list of the successful candidates:—

Rudge, Margaret M., Battersea Polytechnic School of Art, London, S.W. — Design for Printed Muslins.

Lavington, Clara, School of Art, Leeds.—Design for Embroidered Screen.

Harford, Ida, Battersea Polytechnic School of Art, London, S.W.—Design for Printed Muslin.

Metcalf, Arthur, School of Art, Carlisle.—Design for Tiles.

Pickford, Percy, School of Art, Macclesfield.—Design for Tile Panel.

Oldfield, Arthur, School of Art, Macclesfield.—Design for Silk Hanging.

The next award will be made in 1905, when six prizes will be offered for competition.

Proceedings of the Society.

CANTOR LECTURE.

OILS AND FATS—THEIR USES AND APPLICATIONS.

By Dr. J. Lewkowitsch, M.A., F.I.C.

Lecture II.—Delivered February 1st, 1904.

We have seen in the last lecture how the raw oils and fats are prepared by modern methods.

The oils and fats thus obtained are in their fresh state practically neutral. If care be exercised in the process of rendering animal oils and fats, the fatty matter is very often sufficiently pure to be immediately worked up in those industries to which they serve as raw materials. If, however, they are allowed to remain in contact with animal tissue, they are liable to very rapid deterioration. Thus, freshly rendered lard or suet, or even whale oil, will keep sweet for a very long time if protected from light, air, and moisture, whereas the same materials through prolonged contact with putrescible animal matter become dark in colour, and rich in free fatty acids. This is especially exemplified by the five samples of whale oil shown here. Of these, whale oil "No. 0," is perfectly sweet and water white, whereas the lower grades passing through whale oil "No. 1" to "No. 4," become gradually darker, and finally acquire an offensive odour, in consequence of having remained in contact with the flesh and bones for a somewhat prolonged time.

The vegetable oils obtained by expression contain frequently mucilaginous matter and other impurities, such as vegetable fibres, which pass through the press cloths. There are also admixed with the oils traces of moisture, which render them somewhat turbid, dark, and unfit for immediate use; not only for the table, but also for manufacturing purposes. Formerly these impurities were removed from edible oils, such as olive oil, by the simple method of allowing the oils to rest for some length of time, when the moisture and the mucilaginous matter, &c., would settle out. This crude process is no longer employed in large establishments, the clarifying of the oils being much shortened by filtering through a filter press, or brightening by blowing with air.

Other crude oils require more elaborate purification (refining) before they are placed on the market. Notable examples of this kind

are cotton seed oil and rape oil. The sample of Egyptian crude cotton seed oil I show here has been expressed direct from the crushed seed. It ranges from a ruby red to almost black colour, due to the deep dark brown colouring matter contained in the cells of the cotton seed. The oil is refined by treatment with dilute caustic soda; the latter combines with the colouring matter and the free fatty acids in the oil and forms a precipitate which falls down on standing, leaving the oil clear and bright. This crude rape oil, again, is refined by treatment with concentrated sulphuric acid, and yields the refined oils shown here. From these two examples, which can be multiplied by the series of other oils which you have before you, both in the crude and refined state (linseed, castor, fish, sperm oils, and various rape oils, &c.), it may be gathered that the processes adopted on a manufacturing scale vary greatly with the nature of each individual oil or fat.

The methods of bleaching or decolourising oils also vary with each kind of oil or fat. Time permits only of a brief glance at the methods employed on a large scale.

Bleaching by sunlight, one of the oldest processes, is naturally only feasible on a small scale, as the length of time and the space required to expose as large a surface as possible must naturally be costly. Still, in some cases, as in the bleaching of beeswax or in the bleaching of linseed oil for artists' use, this method is being practised. Since the fatty matter undergoes practically no change, the products do not suffer as much as they would in the chemical processes of bleaching.

Bleaching by the aid of chemicals requires great circumspection, the object of bleaching being merely to destroy foreign substances, which impart a dark colour, or other undesirable properties to the oil or fat. The chief attention of the operator must therefore be directed to so treating the raw material that the fatty matter itself is not acted upon. For this purpose, the amount of chemicals must be limited to the smallest possible quantity, the temperature at which they are allowed to act must be as low as possible, and the time of interaction must be as short as possible.

General methods of bleaching chemically, are—(1) Bleaching by means of oxygen; (2) bleaching by means of chlorine.

(1) Bleaching by means of ozone or oxygen gas is still too uncertain a process to be widely used on a large scale, and is only practised in some special instances. I have examined several ozone processes, but although at the first moment they seemed to effect the bleaching satisfactorily, yet after a time the colour of the oils darkened, or as the technical term runs, "reverted."

Bleaching by means of oxygen in *statu nascendi* is chiefly effected by employing manganese dioxide or potassium bichromate and sulphuric acid.

(2) In the processes of bleaching by means of chlorine, bleaching powder, or potassium bichromate and hydrochloric acid are used.

No general rule can be laid down as to which process should be employed in each given case, although it may be stated that tallow is best bleached by means of manganese dioxide, and palm oil by means of bichromate and hydrochloric acid.

The object of bleaching is not only to remove colouring matters for the time being, but to remove them so efficiently that the colour, or even a dark shade, will not "revert" some time after the fat or oil has been bleached. Patents claiming to effect this object appear annually in great numbers, and disappear again when experience has shown that the colouring matter does "revert" to a larger or smaller extent after the material has, *e.g.*, been converted into soap. Thus one of the simplest and most frequently practised processes, that of bleaching tallow, does not produce soaps as good in colour as those made from the freshly rendered tallow. Not only must each kind of fat or oil be considered a special problem, but frequently different varieties of one and the same oil are apt to cause the same difficulties as would a new oil or fat. To mention an example, the bleaching of the softer kinds of palm oil, such as "Lagos" or "Old Calabar," offers very little difficulty. But the harder kinds of palm oil, such as Congo oil, have hitherto withstood all attempts to bleach them.

The above methods of bleaching are, however, inadmissible in the case of those oils and fats which are tendered for *edible purposes*. In these cases we must rely chiefly on physical methods. The oils intended for edible purposes must not even be expressed while hot, and the employment of chemicals involving the use of acids must be altogether excluded, as they impart an objectionable flavour which would render the product useless for edible purposes. Treatment with alkalis in one form or another can only be resorted to in a very moderate degree as, for instance in the refining of cotton seed oil for the table

The absence of free fatty acids in edible oils and fats is a very important desideratum. Hence, in all refining processes, the complete removal of free fatty acids and of the objectionable products which seem to follow in the wake of the once formed free fatty acids, namely, those which impart to the oil the properties we comprise under the term "rancidity," is the chief aim of the manufacturing processes. Alkalis and alkaline earths are almost exclusively used for these purposes.

The physical method consists chiefly in filtering, with a view to brightening the oils by the removal of the adhering moisture and suspended matter of an albuminoid character, and, if colouring matter is to be eliminated at the same time, in treating with either charcoal or fuller's earth. The latter process is, of course, followed by filtration, in order to get rid of the charcoal or fuller's earth, which absorb and retain the colouring matters.

A further requisite of edible oils is that they should not congeal at temperatures near the freezing point. Most olive oils practically fulfil this demand. In the case of cotton seed oil, however, which is at present used in enormous quantities as an edible oil, or for adulterating high-class edible oils, a solid portion, termed "stearine," separates out at a temperature of about 50° F., as exemplified by the specimens before you.

In order to render cotton seed oil suitable for the table, this "stearine" is removed; as the technical term runs, the oil is "demargarinated."

Originally the process of "demargarination" was a natural process, and consisted in allowing the oil to stand in large vessels during the winter, when the "stearine" settled out as a solid mass at the bottom of the vessel, so that the supernatant clear oil could be drawn off. Hence, such "stearine-freed" or "demargarinated" oils are designated by the term: "winter oils."

This simple process has, however, become too expensive, owing to the large amount of capital locked up in the enormous quantities of cotton seed oil that had to be stored. Hence, more rapid processes have been introduced. These consist in artificially refrigerating the oil, and filtering off the "stearine" through filter-presses, or removing it by pressure in hydraulic presses. It need hardly be added that in the latter case the whole process must be carried out in artificially cooled rooms.

Through the introduction of demargarinating processes, oils which were objectionable as table oils on account of their separating "stearine," are being added to the range of edible oils. Such oils are arachis oil, and notably that class of Tunisian olive oils which hitherto could not be mixed with the finest Italian and French olive oils, owing to their being exceptionally rich in "stearine."

The industry of *edible fats* has received, during the last decade, a very great impetus; notwithstanding its rapid development, this industry is, however, in my opinion, still in its infancy. One of the most important edible fats, *butter*, claims to belong to the dairy industry. In the interest of the butter industry itself, manufacturing in large establishments should certainly be preferred to the nursing of a kind of home industry under conditions which are not always above suspicion as regards cleanliness. It is just this element which, in addition to the cheapening of food stuffs, has given the enormous impetus to the manufacture of *margarine*.

The prejudice against this product, which popular ignorance connected with a conglomerate of all kinds of oils and fats, even of fish and train oils and refuse fats, or as a Member of Parliament picturesquely termed it about fifteen years ago, "all the greasy rubbish of the world which is being dumped down in this country," is fast disappearing. If we look at the shop windows of our grocers, it may be said to have already disappeared. The enormous strides which this industry has made are the best possible proof that it has come to stay.

The first and foremost conditions of this industry are the utmost cleanliness and the employment of the purest and freshest materials, combined with the importance of imparting to the product an attractive and even appetising appearance.

From a sanitary point of view, not the slightest objection can be raised against the substitution of cheaper animal or vegetable fats for the expensive cow-butter, and it is rather desirable that this industry should extend, yielding, as it does, cheap palatable food stuffs and thereby tending to exclude from consumption unhealthy fat from diseased animals, prepared under conditions which do not satisfy the most rigorous demands as regards cleanliness.

The origin of the margarine industry dates back to the times of the Franco-German war, when the needs of the beleaguered population of Paris demanded the resumption of earlier

experiments of Mège-Mouriès, which had attracted, a few years before, the attention of the emperor Napoleon.

The fact that butter substitutes lend themselves to fraudulent purposes, as we can unfortunately see every day if we pay some attention to this subject, should be no barrier to the extension of the industry; it is rather the duty of the legislator to render such fraud impossible than to prevent the proper expansion of the margarine industry. Long before margarine made its appearance butter had been adulterated on an immense scale, and the introduction of margarine had a wholesome effect in staying the hands of the adulterator, as the formerly favourite adulterants, such as clay, chalk, gypsum, flour, potato pulp, ground white cheese, and similar substances which used to form the stock-in-trade of the adulterator, have disappeared from the list in order to make room for the harmless, but much less readily detectable, margarine.

Margarine consists chiefly of a mixture of animal and vegetable fats. The animal fats are prepared from the freshest beef fat or hog fat. That obtained from beef fat is known as "oleomargarine," that from hogs —neutral lard— is chiefly employed in the United States. The vegetable oils are cotton seed oil, arachis oil, and sesamé oil. The vegetable oil must be devoid of free fatty acids and should not possess any unpleasant flavour. Thus, neither maize oil, nor even cotton seed oil, can be used for the finest and best brands of margarine, as the particular flavour of these oils would be noticeable in the finished product.

For the production of oleomargarine, the rough fat is removed from the slaughtered animal as quickly as possible and brought into the works, where it is sorted and the kidney fat is selected. This is carefully washed with warm water and thoroughly cleaned. The cleaned fat is then brought immediately into large, well-aired, artificially cooled rooms to dry and harden, being allowed to hang there suspended from tin hooks for several hours. Another process to secure rapid hardening is to immerse the fat first into iced water.

The hard fat is next cut up and shredded in a shredding machine [various types were shown on the screen] and then ground between rollers. The disintegrated mass is immediately introduced into tin-lined, jacketed vessels, at a temperature not exceeding 45° C., this temperature being maintained by hot water contained in the jacket.

In large establishments different kinds of vessels are used, several types of which I exhibit here on the screen.

At the temperature of 45° C., only a portion of the fat contained in the animal tissues separates on the top of the comminuted rough fat. The settling and clearing is assisted by scattering salt over the surface of the melted fat. This melted portion, appropriately termed "premier jus," is carefully syphoned off and run into clean barrels to be sent to the margarine works proper for further treatment. The "premier jus" is not the whole of the fat contained in the charge, but only the first portion that will exude at a temperature of 45°; the remainder of the fat is recovered from the scraps for other purposes which do not interest us here.

If the margarine be produced in the same works, the "premier jus" is allowed to run into shallow, tin-lined trays, arranged in tiers in a cooled room, when the bulk of the "stearine" separates out in a crystalline condition. For the best qualities of margarine, the "premier jus" is remelted, and allowed once more to settle out, after salt has been added, whereby the last traces of membrane and tissue are precipitated. The cleared fat is allowed to run into large vats, in which it stands from three to five days, at a temperature suitable for the crystallisation of the "stearine."

The crystallised mass from the tins is immediately cut up into small pieces weighing about 3 lbs. each. These are wrapped in canvas cloths, and are then put into hydraulic presses. In large works, where the "premier jus" has been allowed to crystallise in huge vats, the whole crystallised mass is stirred up into a homogeneous pulp which is wheeled to the presses and packed into them in small pieces, wrapped in canvas cloth, holding about 3 lbs. each.

[The "premier jus" presses in actual use in the smallest as well as in the largest establishments were here shown on the screen.]

The oleomargarine—"oleo-oil," as it is termed in the United States—runs out into tanks below the presses, to be worked up for margarine. The solid portion which remains in the presses is sold as tallow stearine.

This oleomargarine is the chief raw material for the manufacture of butter substitutes. It is mixed in special churning machines of the various types I illustrate by lantern slides, with vegetable oils and fats and milk.

The milk department forms, therefore, a

substantial portion of the margarine works. On its arrival from the farms the milk must be "pasteurised." As a rule the cream has been taken off before the milk reaches the works, otherwise it is removed by means of a centrifugal machine.

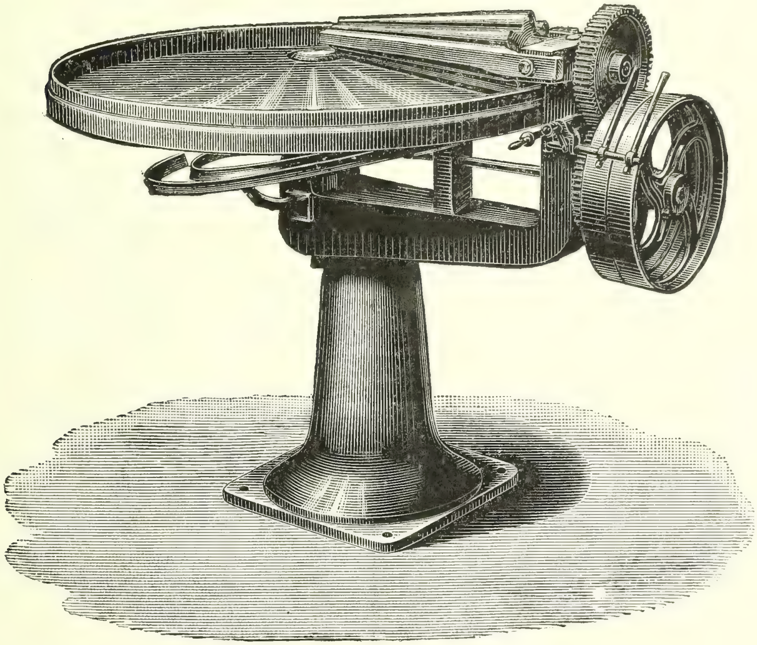
The milk is run, together with the melted oleomargarine and the vegetable oils admixed in accurately weighed off proportions, into churns, in which the whole mass is thoroughly blended. The churning machines consist of oval jacketed vessels, provided with one or two sets of stirring and mixing gear. During the process of churning a constant temperature is maintained by means of steam sent through the jacket of the churn. The object of churning, besides thoroughly mixing the ingredients, is to destroy the tendency of the oleomargarine to crystallise, and to produce a complete emulsion by pulverising the mixture into single globules, such as butter fat forms in milk. When the mass is thoroughly churned, the steam is turned off, and the warm material is cooled by cold water sent through the jacket.

From the churn the cooled margarine is run through wooden shoots into cooling tanks. Whilst running out of the churn the margarine is met in the shutes by a current of ice-cold water, delivered under high pressure, so that the mass is completely pulverised. The disintegrated globules, after solidifying, somewhat resemble butter granules.

In small works the cooling tanks are built of marble; in larger works they simply consist of large wooden tanks. In other works they form very large storage vessels, built up of tiles.

The solidified margarine is taken out by spades, or by long-handled wooden spoons, and placed in wooden wagons, where the admixed water is allowed to drain off. These wagons are carted to large kneading-machines. They consist of huge, circular wooden tables (Fig. 8), which rotate slowly, whilst at the same time a set of conical, fluted, or specially-shaped rollers move along the top of the revolving tables. The margarine is slowly but thoroughly worked through, so that the particles become homogeneous throughout the whole mass. At this stage colouring matters are admixed.

Fig. 8.



The margarine is then salted to taste, and submitted to a further thorough kneading and mixing on a machine similar to the one shown in Fig. 8, or in a specially-constructed churning machine (illustrated by a lantern slide).

The margarine is finally moulded into lumps, pats, rolls, or any other desired shape. [These departments of a margarine works

were illustrated by lantern slides.] Like butter, margarine contains water; the proportion of this should however not exceed 10 to 12 per cent. in well-made preparations. From the description given and the lantern slides shown, it will have become apparent that, throughout the whole process, the fatty material is not touched by the hands of the operator. Thus the process compares favourably with that employed in small out-of-the-way dairies, into the minute details of which we had better not inquire.

The object of the margarine manufacturer is, naturally, to make his product resemble butter as nearly as possible. In order to take away the "tallowy" or exclusively "fatty" taste of the material, some manufacturers, provided the law permit, add butter itself. Others add small quantities of butyric acid, or specially prepared compounds.

An important point is to produce margarine which will froth and "brown" when heated, so that even in cooking the nearest approach to butter is reached. As the property of butter of "browning" and frothing is due to caseïn and milk sugar, it is evident that the more milk is used in the manufacture of margarine, the nearer will the product approximate to butter. This expedient is largely used in this country, but on the Continent, where the law forbids the addition of more than a strictly limited quantity of milk, or its corresponding quantity of butter-fat, a number of curious patents have been taken out for substances purporting to impart the desired property to margarine. Caseïn and other albuninoids are prominent amongst them. The usual crop of excrescences is not wanting in this industry, and even the use of beeswax and vegetable waxes has been patented, although the employment of such substances must be deprecated, as they seriously reduce the digestibility of margarine.

[Tables giving the estimated production of margarine during 1900, and the quantities and kinds of materials used in the production of margarine in the United States will be found on page 925 of my "Technology and Chemical Analysis of Oils, Fats, and Waxes." Macmillan and Co., 1904.]

Another class of edible fats is represented by *lard substitutes*. Their manufacture is in many respects similar to that of butter substitutes, although it is much simpler, since lard substitutes contain no water, and merely represent a mixture of fats. The basis of the lard substitutes should be, of course, lard, with which other oils and fats, such as cotton seed oil and beef fat are intermixed in the melted state.

The enormous quantities of lard substitutes that are produced necessitate rapid cooling of the mass. The simple process of allowing it to cool spontaneously in large vessels is too expensive; hence, special cooling machinery, similar to Petit's cooling wheel (see Lecture IV., Fig. 20) is employed. The wheel of Fig. 20 is replaced by a large hollow cylinder through which cooled brine runs, whilst the sheet of cooled lard thus formed is taken off immediately by means of a pump and filled into tierces.

In the early days of this industry the manufacturers of lard substitutes sailed more closely to the wind than the margarine manufacturer. The lard-substitutes sold under such names as "refined lard," "compound lard," were frequently found to contain no lard whatever, being nothing else than judiciously prepared mixtures of beef stearine—the by-product of the margarine manufacture—and cotton seed oil and other vegetable oils. Here also legislation has had to step in to protect the public.

The detection of cotton seed oil in lard became, therefore, one of the most important problems of the public analyst. A rapid means of detecting it is Halphen's test, which reveals the presence of cotton seed oil by a red colouration. However, too much reliance should not be placed on a rapid test like this, since the adulterator has always been able to keep pace with the latest discoveries of science, and has succeeded in nullifying the indications of this test by treating cotton seed oil in such a manner that it no longer shows the characteristic red colouration. Moreover, some help has accrued to the adulterator through the fact that lard from hogs fed on cotton seed cake exhibits a colour reaction similar to that which lard shows which has actually been adulterated with cotton seed oil.

A third kind of edible fats manufactured on a large scale are *vegetable butters* and the hard fats derived therefrom, which I comprise under the name "*chocolate fats.*" Vegetable butters were first made from cocoa nut oil and palm nut oil, and prepared for the Indian market, where the native population are forbidden by their religious tenets to consume animal fats. Latterly this vegetable butter has, under a variety of fancy names, such as "lactine," "vegetaline," "cocoaline," "laureol," "nucoline," "albene," "palmine," "cocose," &c., found extensive use at

home in confectionery and in the manufacture of margarine, and—it must be feared—is also finding a growing outlet for adulterating cow's butter. From these vegetable butters "chocolate fats" are obtained. The natural chocolate fat is, of course, "cacao butter," which is expressed from the cocoa beans in the course of preparing cocoa. As more cacao butter is obtained from the bean than a properly constituted chocolate should contain, a surplus of cacao butter accumulates in a cocoa works. This surplus is worked up into cheaper kinds of chocolate. Thus a demand has been created for cacao butter. As the natural supply does not suffice, and moreover as cacao butter is the most expensive fat, being even dearer than ordinary cow's butter, there soon arose a demand for a cheap substitute of genuine cacao butter.

Animal fats, such as tallow, are unsuitable for chocolate manufacture, as if not very carefully refined they are apt to impart an unpleasant flavour ("animal flavour") to the finished chocolate.

The best chocolate fat substitutes must, therefore, be prepared from vegetable fats. At present the most suitable substitutes are manufactured from cocoanut and palm nut oils, by removing the softer portions of cocoa nut and palm nut oils in a similar manner as is done in the case of working up the "premier jus." The cocoanut and palm nut oils are allowed to crystallise at a slightly elevated temperature, and the crystallised mass is expressed in hydraulic presses. Whereas in the manufacture of oleomargarine the liquid portion is required, in the present case the hard mass left in the press, termed "cocoanut stearine," or "palm nut stearine," is the desired product.

I show here a number of slabs of "stearines" manufactured in the manner described. These samples represent the pure cocoanut oil and palm nut oil products, and are therefore white; for market purposes these products are generally coloured yellow, in order to more closely imitate, or even surpass, in appearance genuine cacao butter. Such products are sold under a variety of fancy names, such as "cacaoline," "cocoline," &c.

These chocolate fats have the drawback that their melting point is somewhat low. Of course, the more of the softer portion is expressed from the cocoanut oil and palm nut oil, the higher will be the melting point. But since the brands having a high melting point are somewhat costly, products of lower melting point find ready entrance into chocolate works, and it is therefore easy to understand why so many kinds of chocolate become soft in the pocket, or even when held in the hand.

In order to impart greater hardness to the chocolate fats they in their turn are "stiffened," *i.e.*, adulterated with small quantities of animal fats, such as tallow, tallow-stearine, &c. It has even been stated that Japan wax is admixed in order to raise the melting point. Also mineral waxes like paraffin wax, ceresin, have been admixed for "stiffening" purposes, but these should be totally excluded as they are indigestible.

The preparation of suitable chocolate fats from vegetable fats of a higher melting point than cocoanut oil or palm nut oil would, in my opinion, bring us nearer to the solution of the problem. I would suggest for this purpose the working up of some tropical vegetable fats, such as margosa oil, mowrah seed oil, &c.

I have dwelt at some length on the industries of edible oils and fats, as I think that this industry has a great future before it. At present it appears to be in a state of transition. From the large number of patents that are being taken out, it is evident that on all sides strenuous efforts are being made to produce these food stuffs in a palatable, appetising, and at the same time comparatively cheap form.

The extent to which margarine is being consumed in this country may be gathered from the fact that during the year 1902 we imported an amount of margarine valued at £2,569,503. It may be safely assumed that at least an equal quantity is being manufactured at home.

Similarly, the extent to which palm kernel oil and cocoanut oil have been used for edible purposes may be best illustrated by the fact that in the year 1902 about 10,000 tons of these fats were worked up in Europe alone for edible purposes.

Miscellaneous.

*CONNECTION BETWEEN EGYPTIAN AND CELTIC CIVILISATION.**

There is a remarkable connection between the religions, language, customs, and rites of the Ancient Egyptian and those of the ancient Briton. Tacitus

* An address delivered to the Section "Costume, Custom, and Folklore" of the Pan-Celtic Congress, 1904, at Carnarvon, by Sir William Preece, K.C.B., F.R.S.

mentions the mysteries of Germany as being similar to those of Egypt and Britain. Professor John Rhys points out in his "Celtic Britain" that the Druids were so like Egyptian magicians that an old Irish writer calls Jannes and Jambres Egyptian Druids.

In Egypt we are on the threshold of civilisation. Six thousand years ago, government, art, literature, and religion flourished. How many thousands of years were expended in evolving this civilised condition there are no existing means of knowing. Records and inscriptions engraved upon the rock for ever, and written "papyri" in language quite easy to read, teach us that the ancient Egyptian was a better Christian than the Christian of to-day. The oldest book in the world, the "Prisse papyrus," containing the maxims of "Ptah-hetep," was written about 4,500 years ago—maxims that are instructive and directive to-day. The most perfect papyrus is that of Ani, in the British Museum, written about 3,500 years ago. It contains a confession which shows that the ancient Egyptian possessed a conception of sin that might be repeated with advantage now in our places of worship. These documents show that the ethics of the ancient Egyptian were of the highest order. He knew and practised his duty to his God and to his neighbour.

Originally (4500 B.C.) the conception of a Supreme Being, the creator of the world, and the father of heaven, was prevalent. He was symbolised by the Sun, but gradually this simple and grand belief became debased. The people worshipped the symbol rather than the Being. The various attributes of God were subsequently separately symbolised. Each new symbol in its turn was worshipped and idolised; Polytheism became rampant. Each new conqueror, Semite, Persian, Ethiopian, Greek, and Roman, brought with him a new religion which had passed through a similar debasing process. The gods and goddesses multiplied, and confusion became worse confounded. The powers of Nature were personified and apotheosised. Idols, animals, birds, serpents, even trees, rivers, and winds were worshipped. Still, throughout the centuries, the hymns to Amen-Ra, the great god of Egypt, resemble the grand Hebrew Scriptural attributes to our Almighty. However far back we go, even to prehistoric times, as evidenced in the early tombs, a belief existed in an eternal life and a resurrection.

Not much is known of Druidism. The early Celts had no written literature. When they adopted a literature they used the Roman Script. The Ogam inscriptions are comparatively modern. Cæsar, Diodorus, Strabo, Tacitus, Pliny wrote much about the Druids, who were the priests, judges, doctors, teachers, philosophers, scientists, and magicians of the Celts. They knew astronomy. They worshipped the Supreme Being, and they made the oak his symbol. Their only temple was an oak grove, an oak tree being their holy of holies. It was regarded not only as the emblem, but as the temporary residence of God, as Moses regarded the Tabernacle in the wilderness. This was essentially an Egyptian idea. Every Egyptian temple had an inner sanctuary—the holy of holies—where the deity was supposed to reside. The Druids taught an eternal life, and, like the Egyptians, believed in the resurrection, for which they prepared. The establishment of the Greek colony in Marseilles, in 600 B.C., brought Greek influence and Greek ideas into Gaul. The connection between Gaul and Britain was intimate. The simple tenets of early Druidism became debased by the admission of the polytheism of the East.

We know that the Phœnicians were in Spain in 500 B.C., and tradition asserts that they obtained their tin from Britain. Their object in coming to Britain was commerce, not conquest. There is no proof that they occupied any part of the country, but they may have imported the Greek alphabet and some Phœnician and Grecian lore.

The Druids knew and used the mechanical powers. Stonehenge and Avebury, Cromlechs, Logan Stones, Menhirs and Dolmens, testify to their mechanical skill.

They were great rhetoricians and instilled eloquence into their pupils. This art has not disappeared. They practised magic and divination, and performed apparent miracles, as the Egyptian priests did before Pharoah, and in which Moses and Aaron excelled. The Druid contest between the Dedannans and Firbolgs, in Ireland, where magical fogs and storms were raised, and in which the former prevailed owing to their superior skill, recall this contest detailed in Exodus.

Pliny says, "In Britain the magic arts are cultivated with such astonishing success, and so many ceremonies, at this day, that the Briton seems to be capable of instructing even the Persians themselves in these arts." Most of the magic of this period seems to be only the science of to-day.

The term Druid means a chief priest; it is derived from "der" superior, and "gwydd," a priest or instructor. There were two classes, "Derwydds" (Druids) and "Go-wydds" (Ovids). Strabo divided them into three classes, "bardi," "vates," and "druides." Every chief had his druid, and every chief druid had his guard of thirty men. They were wealthy, but they borrowed money to be paid in the life to come.

> "Like money by the Druids borrowed
> In t'other world to be restored."
>
> HUDIBRAS.

This practice, I believe, has not yet left Wales.

In all countries nations come and go. The ruling race changes frequently, but the workers remain. The fighting men are killed off, but the mothers and children flourish, and with them their language. It is impossible to eradicate a language. The Cymraeg of to-day is virtually the speech of the ancient Briton. The Coptic of to-day retains the roots, idiom, and form of the ancient Egyptian. Thought and early education is conducted in the language of the mother and of childhood, and thus from generation to generation

the Welsh and Irish of to-day retain the form and roots of the early Celts. French and Spanish are but modern forms of Latin. We are assembled here to foster and preserve the purity and value of the living Celtic languages.

Professor Rhys pointed out that the Celtic language is full of a pre-Aryan influence, and Professor Morris Jones has dealt ably with the pre-Aryan Syntax in Insular Celtic. The aborigines of Wales were probably savages, but they were ousted by the Iberians, who came there through Gaul and Spain from North Africa. The Copts and the Berbers are their survivals to-day in and near Egypt. Ethnology proves this by the shape of the skull, and philology confirms it by the similarity of language. Ancient Egyptian agrees very closely with this pre-Celtic dialect, not only in the order of words in a sentence, the peculiar personal suffixes, the periphrastic conjugation of pronouns and prepositions—the mode of word-building —but in the remarkable use of letters and single syllables which have no equivalent in English, and an apparent system of mutation. In many cases the co-incidence is absolute. The verb in these languages comes before the subject. This is not the case in any Aryan tongue. It is impossible to ignore this remarkable connection or to resist the conclusion that Welsh and ancient Egyptian are closely allied. Time will not allow me to give the proofs, but a reference to Professor Morris Jones's admirable paper* will fill the want. It is, however, peculiar that we have no evidence in Celtic of hieroglyphic or hieratic writing. This may be due to the fact that the Iberians left Egypt very early in prehistoric times.

In Egypt, history commences with "Mena," who was either a god, a hero, or a king. It was a name to conjure with. It is found everywhere on the banks of the Nile. So in Britain we have "Mon," "Manannan," "Man," "Menai." [Menw or Menyw is recorded as one of the first instructors and legislators of Cymry.] The Eastern influence is seen in the formation of personal names. There is more that is Semitic in this practice than Aryan. We find in Irish—

Cu Chorb—Corb's Hound.
Fer Corb—Corb's Man.
Nia Corb—Corb's Champion.
Mac Corb—Corb's Son.
Mug Corb—Corb's Slave.

The modern Gilmore in Scotland is "Gillie Muire" —the Servant of Mary.

In Arabic to-day, we have

Abdallah—the Son of God.
Abd-el-Kadr—the Slave of Kadr.

In Welsh

Ap Rhys—the Son of Rhys.

The Aryan practice as seen in Greek and Latin, and continued in modern Europe, is quite different. Professor Rhys says:—"No evidence could well be more conclusive as to the former presence in these islands of a population of natives of non-Aryan origin."—"Welsh People," p. 74.

There is great similarity in the name of the gods of Egypt and of the Celts, "Teutates" of the Celt was "Tehuti" of the Egyptian—a name which remains in our English Tuesday.

One more link—the Aryan race has been everywhere patriarchal, but the Berber and pre-Aryan race in Britain were matriarchal. I have no evidence of the existence of this system in ancient Egypt, but the Pharaonic system of marrying one's sister leads one to think that it may have been in existence. When the king died in Berber or was deposed—a common occurrence—it was not his son who succeeded him, but the son of his sister. The matriarchal system still exists in Southern India, but it is dying out fast. It is peculiar that "nephew," which in Latin is *nepos* and in Celtic, *avias*, in Irish became "na" or "o," *re* sister's son. All the "o's" in Ireland proclaim an ancient matriarchal system in that country.

We have very early representations on the monuments, papyri and tombs in Egypt of the vestments and duties of the priest. The distinguishing feature of the dress of a chief priest is a short white petticoat like a kilt, and the skin of an animal—lion, tiger, or panther—thrown gracefully over his shoulders, with the tail hanging down his back and the paws in front. Sometimes he is shown wearing a long white surplice.

The Druids also wore long white surplices. They carried a wand and wore amulets—the "Druids' egg" —about their necks. They, like the Egyptians, were fond of ornaments, gold chains, brooches, and bracelets. The word "surplice" is derived from "super" over, and "pellis" a skin, and we can assume from this that they wore skins under this garment.

Both the Egyptians and the Druids had mysterious dances in their ritual. Each had arks or boats in their religious processions. The Druidical ark was a symbol of the deluge, and was undoubtedly Aryan in its origin. I have not found any tradition of the deluge in ancient Egyptian lore, but my survey is quite limited.

Egyptian religion is characterised by the worship of animals—particularly "the bull"—a symbol of courage and strength. The Druids had "Hu," the royal bull, and "Beuno," the ox of the ship. ("Bu," an ox, and "Naw," a ship.) In Ireland we have the magical bull of Cooley—the object of Queen Maeve's famous raid.

The worship of Isis (Ceridwen) was brought into Britain by a tribe called "Pharaon" (or the higher powers) by the ancient British. Their priests (Pheryll) were metallurgists, and they possessed books of magic. They came into Wales from Cornwall, and they introduced the worship of the eagle and wolf. Snowdon was made their headquarters. They were probably Phœnicians. The Egyptians worshipped both the eagle and the wolf. "Asyut" was called by the Greeks "Lycopolis," "wolf city," and wolf mummies are abundant there. I brought a mummied wolf's skull home with me.

* *Vide* "The Welsh People," by John Rhys and D. Brynmor Jones. Appendix B. London, 1900.

The name "Pharaon" and the cult of the eagle and the wolf are most suggestive. Davies says that this people's rites "passed from Egypt and Syria into Phrygia and Pontus, from thence into Thrace and the cities of Greece. They were carried into Etruria, and thence into the regions of the Celtæ."

The Phœnicians and Etruscans were probably the same people. Recently they have been associated with the Hittites and with the Hyksos or Shepherd Kings who ruled over Egypt for 500 years 2200 years B.C. to 1700 B.C. This is perhaps the time when they influenced Britain. It is known that the Phœnicians were trading with Britain before the days of Homer.

The peculiar tenets held by the ancient Egyptians and by the ancient Britons, the beliefs in the Supreme Being, the future life and the resurrection prepared both nations for Christianity, and when the missionaries came, Egypt, sick of Roman paganism and gross immorality, unanimously embraced the new religion, while the ancient Briton was not slow to follow the same example.

The ethics of the Druids impressed on the nation the doctrines:—

(1) To worship God.
(2) To do no evil.
(3) To be valiant in battle.

This teaching has not been lost on us. The Welsh nation is externally, and on Sundays a very religious nation, but their internal practices of Christian ethics would be very much improved if we could impress upon them the maxims of Phtah-hetep and Ani, Egyptian magnates of about 5,000 years ago.

*LARGE BULB INCANDESCENT ELECTRIC LAMPS AS SECONDARY STANDARDS OF LIGHT.**

The importance of possessing a secondary standard of light which shall be at once portable, convenient, and constant is generally acknowledged, and the choice lies between some form of flame standard and some form of incandescent standard.

It is known that the candle-power of a flame standard is affected by the variation of moisture in the air, atmospheric pressure, and carbonic acid, and that even in well-ventilated rooms changes in atmospheric moisture and pressure may cause variations to the extent of 4 per cent. in the candle-power of a flame standard.

For the last eight years the author has employed as a secondary standard of light a form of carbon filament incandescent lamp, having a specially large bulb and a filament prepared in a certain manner. The size of the bulb prevents any sensible deposit of carbon upon it, and the particular preparation of the filament, by ageing it previously to mounting in the bulb, prevents variations in candle-power, provided the lamp is used in a particular manner, and only for a short time on each occasion. These large bulb lamps are not intended for continuous use, but only to be employed in setting or adjusting the distance of another lamp from the photometer disc in a photometer, so as to produce on the disc a predetermined illumination. The lamp to be measured is then substituted for the standard lamp, and by this process of double weighing all errors due to want of symmetry in the photometer are eliminated. If only used in the above manner the standard lamps may be used for hundreds of times without being in operation altogether for more than a few hours, and by comparing a number of these standards with one another it is possible to preserve a standard of light with great constancy. The illuminating power of the lamps is not affected by changes in moisture and atmospheric pressure, and the experiments described in the paper show that they are not sensibly affected by change in atmospheric temperature. The light of the lamp is, therefore, determined only by the current passing through it, and this can be measured easily with an accuracy of one part in a thousand by means of a potentiometer. Hence, when the filament is traversed by the same current, the lamp gives the same light. The author has therefore devised an arrangement consisting of a large bulb lamp united with a current measuring instrument and a variable resistance. This instrument, however, is not graduated directly to read current, but is graduated to read candle-power; hence all that has to be done is to place the instrument on a circuit supplying a steady electromotive force and vary the current through the lamp by means of a rheostat until the needle of the current-measuring instrument indicates a certain candle-power. The lamp then has a known candle-power in a certain direction. Such an arrangement, although not sensitive enough for laboratory purposes, is quite sufficiently accurate and very convenient for the workshop comparison of ordinary glow lamps. For more accurate observations, however, a potentiometer must be employed, since the current or the voltage on the terminals of the lamp must be determined to at least one part in a thousand, if the candle-power is to be correct within half a per cent. If incandescent lamps are compared directly with flame standards, the latter not being corrected for atmospheric moisture and pressure, then differences to the extent of even 4 or 5 per cent. may be found in measuring the candle-power of the incandescent lamp on different occasions and in different places. As this difference amounts to about one candle in twenty-five it is far greater than possible errors in observations made with due care.

For the purpose of bringing into agreement photometric measurements made in different parts of the world, these large bulb standard photometric lamps have proved very useful, and also they have proved of utility in obtaining the proper coefficients for the correction of the candle-power of flame standards for atmospheric moisture and temperature.

* Abstract of a paper by Prof. J. A. Fleming, M.A., D.Sc., F.R.S., read before Section G of the British Association at Cambridge.

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

EXAMINATIONS.

The Programme for 1905 is now ready, and can be had, price 3d., on application to the Secretary, Society of Arts, Adelphi, London, W.C.

The Examinations will commence on Monday, April 10th, 1905.

Proceedings of the Society.

CANTOR LECTURE.

OILS AND FATS—THEIR USES AND APPLICATIONS.

By Dr. J. Lewkowitsch, M.A., F.I.C.

Lecture III.—Delivered February 8th, 1904.

Burning Oils.

Whilst in the industry of edible oils it is of paramount importance to remove the free fatty acids, less rigorous demands are made in those cases where oils are used for industrial purposes. But even here, as in the case of burning oils, the amount of free fatty acids must not be too large.

At the present day, when we see electric light everywhere, and gas is supplied for illuminating purposes even in small villages, the mention of burning oils may perhaps strike one as an anachronism. But up to the middle of the last century, olive oil, rape oils, and other vegetable oils were widely, if not exclusively, used as the burning oil of the middle and lower classes, to whom the price of candles was prohibitive.

It is only with the advent of paraffin oil that the use of fatty burning oils has become restricted. But even at the present day large quantities are still required for burning purposes, as the collection of burning oils exhibited on the table demonstrates. To take an example, in Norway whale oil is largely used nowadays for illuminating purposes. Whale oil and seal oil, especially of the water white qualities, are still in demand for lighthouses.

Railway companies still use enormous quantities of rape oil in this country, just as in America lard oil, and in Italy olive oil, are required for burning on railways (illuminating signals, &c.).

In the case of burning oils, refining must be carried out somewhat carefully, and the amount of free fatty acids must not exceed 3 to 5 per cent., as otherwise the wick of the lamp easily becomes clogged. Of what great importance this is in railway signalling can well be imagined, when the fact is borne in mind that many lamps are relied upon to burn brightly for a certain number of hours without requiring attention.

Lubricating Oils.

Another class of oils which must also be somewhat carefully refined is that of lubricating oils. The chief fats and oils used for lubricating are tallow, lard oil, tallow oil, olive oil, rape oil, and I may add sperm oil, although chemically considered it is not a fatty oil, but falls under the definition of a wax. Before mineral oils appeared in the market, these oils were used exclusively as lubricants, but since the enormous industry of mineral lubricating oils has been created, the importance of the fatty oils in this respect has greatly diminished, although they still play a very considerable part in the manufacture of lubricating oils. It cannot be contested that a certain admixture of fatty oils with mineral oils gives better results in the lubricating of steam cylinders than mineral oils alone.

Railway companies employ rape oil as the lubricating oil *par excellence*.

In this connection, it may strike one as an anomaly that India exports practically her total yield of rape seed to this country, and takes back rape oil, which is almost exclusively used for lubricating the axles of her railway locomotives.

Olive oil is in this country too expensive for lubricating purposes, for the cheaper kinds contain too large quantities of free fatty acids, a fact which, of course, precludes their use.

Tallow oil and lard are still employed to a large extent.

Drying oils are utterly unsuitable for lubricating purposes, as they resinify rapidly and clog up the machinery. Also semi-drying oils, like cotton seed oil and maize oil, are unsuitable. Since cotton seed oil is extensively employed in other directions, the advertising of this oil in this respect has ceased, and the goodwill thereof has fallen to maize oil, the enormous quantities of which are still seeking new outlets.

All the oils mentioned are readily miscible with mineral oils, and hence the "blends" prepared from mineral oils and fatty oils are of the greatest possible variety. The only fatty oil which will not mix in all proportions with mineral oils is castor oil; and as castor oil, on account of its high specific gravity, is a desirable ingredient in lubricating oils, the expedient is resorted to of mixing castor oil first with a fatty oil, say tallow oil, and then adding mineral oil.

The high price at which castor oil stood some years ago, led to the manufacture of oils simulating castor oil in respect of high specific gravity and viscosity. These oils are known under the name of "blown" oils or soluble castor oils. They are made by blowing a current of air into the slightly-warmed oils in a machine such as I show on the screen, when oxygen is absorbed and so much heat generated, that the reaction proceeds without any further heat being applied. Sometimes the rise of temperature is so great that the oil must be cooled. Especially suitable for the manufacture of these blown oils are the semi-drying oils, The samples of blown rape oil, blown cotton seed oil, blown ravison oil, blown maize oil, and blown seal oil I show here, illustrate the wide range of these oils.

Opinions as to the suitability of these oils for lubricating purposes are still conflicting, objection being taken to them by many engineers on account of their liability to gum and their low flash points.

Paint Oils.

A great industry, consuming large quantities of oils, is that of paint oils. The paint oil *par excellence* is linseed oil. A few years ago, when the price of linseed oil was twice as high as it is at present, substitutes were largely in demand. The best substitutes will, of course, be those oils which are most nearly related to linseed oil, and the proper linseed oil substitutes must therefore be looked for amongst vegetable drying oils. As possible linseed oil substitutes, I show here candle nut oil, safflower oil, tung oil, niger seed oil, poppy seed oil, walnut oil. Although at present, on account of the fall in price of linseed oil, the stimulus for the production of these oils has been removed, they may, at any time when the turn of the wheel brings forth again high prices for linseed oil, force themselves on the attention of the manufacturer. The safflower oil of India, and the candle nut oil of the South Sea Islands may then deserve more attention than is at present bestowed upon them.

Especial varieties of paint oils are those which are required for artists' use, and here with the exception of poppy seed oil and walnut oil, which find great favour with artists for the best white paints, linseed oil bleached by sunlight is employed.

Recently several processes for bleaching linseed oil by ozone have been worked on an experimental scale, but so far, and I speak from experience, having investigated myself several ozone processes, the natural oil is not surpassed by ozonised oils.

Semi-drying oils are unsuitable, and although maize oil, enormous quantities of which were pressed heavily on the American market a few years ago, has been widely advertised as a paint oil, it must stand condemned as unsuitable for that purpose.

Boiled Oils.

The value of the drying oils rests on a remarkable property they possess, viz., that of absorbing oxygen from the air. Linseed oil is capable of taking up as much as 20 per cent. of its own weight in the course of about three days, passing from its oily state through an intermediate stage of a viscous, then tacky substance, until it is converted into a thin, elastic, flexible skin. The rapidity of drying can be much accelerated by the process of "boiling" the oil, that is, heating the oil with certain metallic oxides to a high temperature.

The invention of this process of "boiling" has been ascribed to the Dutch painter, Van Eyck; and we can well imagine how empiricism led an artist who had to mix the pigments with oil to discover such a process. Although several centuries have elapsed since this discovery was made, we are still unable fully to understand the chemical change which takes place when an oil boiled with metallic oxide dries.

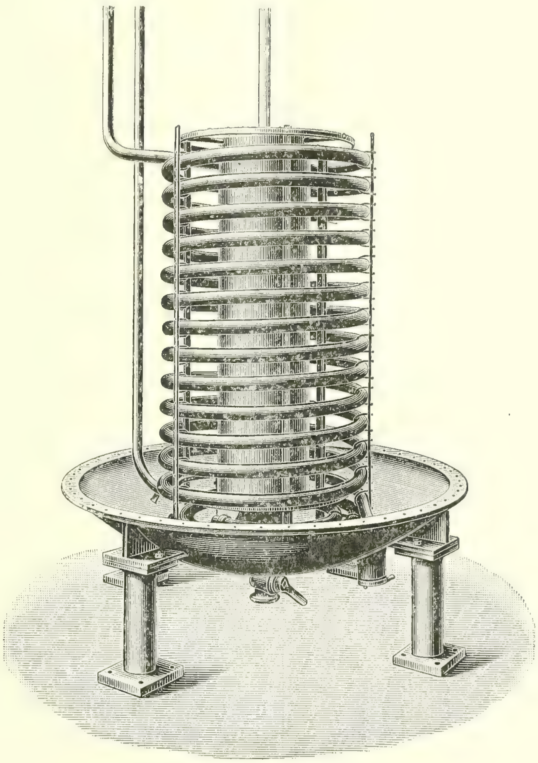
For some time it was assumed that the oil

itself became oxidised, the glyceridic part of the oil being attacked in the first instance. But this view must be rejected as erroneous, since "boiled" oil retains almost its whole quantity of glycerin. Moreover, practice has shown that the glyceridic part of boiled oil is a necessary ingredient, and several attempts, for which patents have been taken out, to prepare boiled oils from the fatty acids, after the removal of the glycerin, have led to useless products. The explanation was then suggested that the metallic oxides act as oxygen carriers during the boiling, but the process of boiling certainly does not consist in an oxidation of the oil, since if oxidation really does take place, it cannot exceed a very slight amount. In the investigation of an ozone process, I have noticed that oils treated with oxygen acquire all the properties of boiled oils, although chemically speaking they had undergone a very slight change only.

Furthermore, recent progress has shown that a high temperature is not required for the preparation of boiled oils, as we are able to obtain oils having the property of boiled oils by carefully grinding linseed oil in the cold with manganese borate.

Much lower temperatures than are required in the old process of boiling have been found sufficient. Thus at present the bulk of the boiled oils is obtained by heating linseed oil with driers to a temperature of 150°C only. The process is carried out by introducing the oil into a cylindrical vessel, provided with a heating coil and an agitating gear, so as to produce an intimate intermixture between oil and drier whilst they are heated to the desired temperature. The internal arrangement of a modern oil boiling vessel is illustrated by Fig. 9. Here the cylindrical part of the vessel, to which a small steam engine driving the agitating gear is attached, has been removed in order to show the heating coil and stirring apparatus.

Fig. 9.



The temperature employed in boiling can be still further lowered since modern driers have been introduced, especially those known as *liquid driers*. These liquid driers consist of a solution of lead linoleate or even of resinate in boiled oil or linseed oil.

A very complete collection of driers which are obtainable in the trade is before you on the table. I have added a drier which I prepared on a somewhat large scale from tung oil and have termed "tungate drier."

These driers, especially the liquid driers, have led to a great deal of secretmongering. They are sold under a variety of fancy names of which the best known is perhaps "terebene." A few per cent. of these driers added to linseed oil at temperatures of 120-150° C. is able to impart to the oil the properties of boiled oil. The mania for cheapening has even gone so far that "boiled" oils are prepared by merely pouring a solution of these driers into linseed oil in the cold. Such oils, which the Americans in their characteristic jargon call "boiled through the bunghole" are distinctly inferior to oils prepared by the aforementioned processes.

Now, if a mere dissolving of the drier in the oil is sufficient, then no important chemical change can have taken place. Yet the only explanation which commends itself at present, and in support of which I have published elsewhere a number of experiments, is that the oil becomes polymerised. The first outward sign of this consists in the oil acquiring a higher specific gravity. This explanation gains support in the fact that by merely heating linseed oil without any driers an increase of specific gravity, or polymerisation, takes place.

Processes based on this reaction have been practiced very extensively for many years, and I need only mention the words "printing ink" and "lithographic varnishes" in order to recall to your mind the important industries which are based on this property of drying oils to become polymerised. (Samples of lithographic varnishes were shown.)

Another illustration of a far-reaching polymerisation is given by the example of *tung oil*. If this oil is heated to 180° C. for several hours, or to 250° C. for a short time, it solidifies to the jelly-like mass I show here.

The boiled oils find extensive employment not only in our ordinary paints; enormous quantities are used in the *varnish industry*. The theory of this manufacture is simple. It consists in dissolving suitably-prepared gums and resins (a representative selection of which is exhibited on the table) in linseed oil and "boiling" the mixture. The "varnish oil" so obtained is thinned down with oil of turps. Simple as the manufacture appears, this industry is still surrounded by an enormous amount of secretmongering, and the light of scientific investigation has so far hardly penetrated into this industry. Each varnish maker jealously guards his recipes, and envelops his mode of manufacture in an atmosphere of the deepest mystery.

It must be hoped that industry will emerge from its darkness through scientific progress, much as the soap industry has emancipated itself, to its great advantage, from the secrecy which the foreman soap boiler found it to his interest to maintain.

Oxidised Oils.

If the oxidation of linseed oil is carried further until the maximum amount of oxygen is absorbed, we obtain the "solid linseed oil" (samples of which, made by various processes, I show here), representing an elastic jelly-like mass. It is prepared by allowing linseed oil, previously boiled with a drier so as to accelerate the oxygen absorption, to run over a light cotton fabric—"scrim"—hanging from the ceiling of a high building kept at a temperature of about 100° F., so that the oil, whilst trickling down from the top of the house, is capable of absorbing rapidly the maximum amount of oxygen. A portion of the oil solidifies on the fabric, the oil which drains off at the bottom being pumped up again, and allowed to run down, until the layers of the solid mass have reached, after several weeks, a thickness of about half an inch. This process is termed the "scrim process;" the solidified oil obtained by this method is termed "scrim oil."

Another method consists in passing a current of oxygen through linseed oil mixed with a small percentage of drier in a closed jacketed vessel heated by steam, until the maximum amount of oxygen has been absorbed. The hot mass will still run, but after cooling it sets to a jelly-like mass which is dry enough and solid enough to be packed into bags. These materials form one of the chief ingredients of "linoleum," the invention of Walton and his successors. For this purpose, the "scrim oil" is mixed with rosin and ground cork, rolled on a jute canvas backing, and is finally seasoned at a temperature of 75° before it is placed on the market in its well known form.

Vulcanised Oils.

If in the last described process we substitute sulphur for oxygen, we obtain that class of oils which are best described as "vulcanised oils." The treatment is similar to that which india-

rubber undergoes in the vulcanising process, and just as in india-rubber vulcanising we have two processes, viz., the "hot cure" (treating the india-rubber with sulphur at a high temperature), and the "cold cure" (treating with sulphur chloride at a low temperature), so we can produce the vulcanised oils either by treatment with sulphur at a higher temperature, or with sulphur chloride at the ordinary temperature.

The reaction is almost instantaneous in the case of castor oil; hence I am able to show it here on a small scale. Although I am tempering the reaction by first dissolving both the oil and the sulphur chloride in carbon bisulphide, you note that by stirring together these two solutions a solid product is formed in about half a minute, so that on turning the capsule upside down a solid product falls on the table.

Other oils, such as linseed oil and rape oil, require a little longer time, and a somewhat elevated temperature. The products so obtained have acquired commercial importance. They form a mass possessed of not very great elasticity; and are chiefly employed to adulterate ("cheapen," as it is called euphemistically) india-rubber goods. The great deterioration which india-rubber goods exhibit (during the last decade or two) is due to the extensive employment of these substitutes.

Sulphonated Oils.

Oils and fats undergo a somewhat deeper change when they are treated with concentrated sulphuric acid. They combine with this acid and form water-soluble products. On this reaction is based the industry of *turkey-red oils*.

This class of oils is prepared by allowing concentrated sulphuric acid to run into castor oil slowly, with constant stirring, taking care that a temperature of 35°C. is not exceeded. The product is then mixed with water and allowed to settle out; the lower layer is drawn up and washed with a solution of sodium sulphate until the acid is practically removed. Finally ammonia is added until the sample gives a clear solution with a small quantity of water. [Experiment shown.]

At times, when castor oil was high in price, cheaper substitutes, such as cotton-seed oil, &c., were used. At present, however, the price of castor oil is so low that it would not pay to employ anything but the genuine oil.

The manufacture of turkey-red oils forms as it were an intermediate link between those industries in which the glycerides undergo a more or less pronounced chemical change but are not saponified, and those industries which are based on the hydrolysis (saponification) of oils and fats. The latter industries comprise the manufacture of *stearine candles*, *soaps*, and *glycerin*.

Hydrolysis of Oils and Fats.

In order fully to understand the chemical reactions which take place, and lie at the basis of these industries, it is necessary to consider the theoretical constitution of the glycerides of which the natural oils and fats consist.

The glycerides may be looked upon as salts formed by the union of the tribasic substance glycerol (glycerin) $C_3H_5\begin{matrix}OH\\OH\\OH\end{matrix}$ and three molecules of fatty acids. The latter may be represented by the formula R.OH in which R denotes the radicle (radical) of any fatty acids. The formation of the glycerides may therefore be expressed by the following equation—

$$C_3H_5\begin{matrix}O.H\\O.H\\O.H\end{matrix} + 3\,R.OH = C_3H_5\begin{matrix}O.R\\O.R\\O.R\end{matrix} + 3\,H_2O \qquad (1)$$

Now, if instead of 3 ROH, *i.e.*, 3 molecules, only *one* molecule of fatty acid were allowed in the equation (1), the substitution of only one hydrogen atom "H" in the glycerol, by one radicle of the fatty acid "R," can take place. We should then obtain a substance having the formula—

$$C_3H_5\begin{matrix}O.R\\O.H\\O.H\end{matrix}$$

A compound having this composition is termed a *monoglyceride*.

According to the position which the "R" takes up in the molecule, two different monoglycerides are possible, as expressed by the two formulæ:—

$$C_3H_5\begin{matrix}O.R\\O.H\\O.H\end{matrix} \qquad C_3H_5\begin{matrix}O.H\\O.R\\O.H\end{matrix}$$

If we denominate a monoglyceride represented by the first formula α-monoglyceride, a monoglyceride represented by the second formula would be appropriately termed β-monoglyceride.

Hitherto, glycerides of the α-form only have been obtained, but there should be no difficulty in preparing also the β-compounds.

If we substitute in the above equation (1) *two*

hydrogen atoms by two radicles of fatty acids, we obtain a compound of the general formula—

$$C_3H_5 \begin{matrix} O.R \\ O.R \\ O.H \end{matrix}$$

Substances having this composition are termed *diglycerides*.

It is evident from the last formula that here again two different (" isomeric ") diglycerides are possible, according to the position of the (radicles) " R's " in the molecule. This is expressed by the two following formulæ :—

$$C_3H_5 \begin{matrix} O.R \\ O.H \\ O.R \end{matrix} \qquad C_3H_5 \begin{matrix} O.R \\ O.R \\ O.H \end{matrix}$$

The first compound is termed α-diglyceride, and the second β-diglyceride.

Representatives of both the α- and the β-compounds have been prepared in the laboratory.

[Lantern slides were then exhibited, giving in tabular arrangement a list of the monoglycerides and diglycerides prepared hitherto.*]

If in the above equation (1) all three hydrogen atoms are replaced by "R," we obtain the *triglycerides*. I show in a lantern slide those triglycerides which have been obtained hitherto in a state of purity.†

Hitherto it has been assumed that the naturally occurring glycerides represent mixtures of triglycerides in which all three radicles of the fatty acid are of *one and the same* composition. Hence most natural oils and fats were looked upon as consisting of mixtures of the most frequently occurring triglycerides :— Tripalmitin, tristearin, and triolein.

The general formula of the triglycerides is therefore expressed by the following formula—

$$C_3H_5 \begin{matrix} O.R \\ O.R \\ O.R \end{matrix}$$

Theoretically, we may assume that the fatty acid radicles "R" may be of different composition. Hence, if we denominate the glycerides of the formula—

$$C_3H_5 \begin{matrix} O.R \\ O.R \\ O.R \end{matrix}$$

simple glycerides, such glycerides in which the acid radicles are not alike, must be termed *mixed glycerides*.

It is evident that only *one* form of a simple triglyceride can exist. But if radicles of different composition enter into combination with glycerol, then we have two possibilities :—

1. Two "R's," denominated R_2 and R_2, are alike, but differ from the third radicle, denominated R_1.

2. All three "R's," denominated R_1, R_2, R_3, differ from each other.

It will be seen that in the first case *two* different triglycerides are possible, as shown by the formulæ :—

$$C_3H_5 \begin{matrix} O.R_1 \\ O.R_2 \\ O.R_2 \end{matrix} \qquad C_3H_5 \begin{matrix} O.R_2 \\ O.R_1 \\ O.R_2 \end{matrix}$$

In the second case *three* isomerides are possible, as explained by the following formulæ :—

$$C_3H_5 \begin{matrix} O.R_1 \\ O.R_2 \\ O.R_3 \end{matrix} \qquad C_3H_5 \begin{matrix} O.R_2 \\ O.R_1 \\ O.R_3 \end{matrix} \qquad C_3H_5 \begin{matrix} O.R_1 \\ O.R_3 \\ O.R_2 \end{matrix}$$

To repeat, whereas only *one* simple triglyceride of any fatty acid can exist, there may exist *two* mixed triglycerides in which two different acid radicles (R_1 and R_2) are combined with one molecule of glycerol, and *three* different mixed triglycerides in which all three acid radicles, R_1, R_2, R_3, are different.

We are therefore confronted with the likelihood of meeting in the natural products representatives of all theoretically possible glycerides. Hitherto, hardly more than a beginning has been made in the investigation of this somewhat complicated-looking problem. Only a few years ago the first mixed glyceride—*oleodistearin*—was discovered in Mkányi fat, and it is characteristic that this discovery has been made in the course of an examination of one of the foreign vegetable fats which the German Government is having examined in an institution which, in this respect, fulfils similar functions to those of our Imperial Institute.

The methods by which the *mixed* glycerides are isolated from the natural oils and fats are still of an exclusively scientific character. Such triglycerides have since been discovered in olive oil, cacao butter, lard, and human fat. It is impossible to say at the present moment what will be the outcome of the large vista of researches thus thrown open. To the practical manufacturer who merely looks to the obtainment of mixed fatty acids and glycerin, it is immaterial whether the natural oils and fats consist of mixed glycerides or of mixtures of simple glycerides.

On reversing the above given equation (1), and writing it in the following manner, taking M to stand for a hydrogen atom, it reads to mean

* Compare Lewkowitsch, "Laboratory Companion to the Oils and Fats Industries," Tables 1 and 2, pp. 8 and 9 ; as also Lewkowitsch, " Chemical Technology and Analysis of Oils, Fats, and Waxes," 1904, pp. 4 to 7.

† Compare "Laboratory Companion to the Fats and Oils Industries," Table 3, pp. 10 and 11 ; also "Chemical Technology and Analysis of Oils, Fats, and Waxes," 1904, pp. 7 to 16.

that the triglycerides are decomposed by water into fatty acids and glycerol (glycerin)—

$$C_3H_5\begin{matrix}O.R\\O.R\\O.R\end{matrix} + 3\,MOH = C_3H_5\begin{matrix}O.M\\O.M\\O.M\end{matrix} + 3\,R.OH \quad . . (2)$$

[If M denotes a monovalent metal, such as sodium, Na, or potassium, K, then the equation would mean that the triglyceride is decomposed by sodium hydrate (or potassium hydrate) into sodium (or potassium) salts of fatty acids and glycerin.]

Just as we have seen above, that by bringing together glycerol (glycerin) and successively three molecules of fatty acids, we can trace the formation of a triglyceride through the intermediate stages of a monoglyceride and diglyceride, so can we assume that the last equation (2) is merely a summary of three reactions, taking place one after the other. This is expressed by the following three equations :—

$$C_3H_5\begin{matrix}O.R\\O.R\\O.R\end{matrix} + M.OH = C_3H_5\begin{matrix}O.M\\O.R\\O.R\end{matrix} + R.OH \quad .. (2a)$$

$$C_3H_5\begin{matrix}O.M\\O.R\\O.R\end{matrix} + M.OH = C_3H_5\begin{matrix}O.M\\O.M\\O.R\end{matrix} + R.OH \quad .. (2b)$$

$$C_3H_5\begin{matrix}O.M\\O.M\\O.R\end{matrix} + M.OH = C_3H_5\begin{matrix}O.M\\O.M\\O.M\end{matrix} + R.OH \quad .. (2c)$$

These equations express by means of chemical symbols that at first (equation 2a) *one* radicle of fatty acid is replaced by M with the formation of the diglyceride ; that this diglyceride is then further acted upon (equation 2b) by one M.OH with the formation of the monoglyceride, and that the latter is finally converted (equation 2c) by a third molecule of M.OH into glycerol (glycerin), and the third molecule of fatty acids. On adding the three equations together, we arrive of course at the equation (2) given above.

It would appear that for practical purposes it is pretty immaterial whether the reaction takes place in three stages, or in one stage only, as the manufacturer is solely concerned with the final result. Still, from a theoretical point of view, it is interesting to ascertain whether these three stages can be shown actually to occur. Once the theoretical possibility is established, practical conclusions will follow in the natural course.

Now, I have been able to show by actual experiments that hydrolysis does take place in three stages. It cannot be expected that these three stages follow each other consecutively, in distinct succession, or, in other words, we cannot expect to find that the whole mass of triglycerides is at first hydrolysed exclusively to diglycerides, as indicated by the equation (2a), that the diglycerides are then broken down to monoglycerides as shown by the equation (2b), and that, finally, the monoglycerides so formed are converted into glycerol and free fatty acids. We shall rather find that all the three phases expressed by the above three equations take place concurrently, so that at one and the same time one molecule of diglyceride may have been broken down to monoglyceride and fatty acid, or one molecule of monoglyceride to glycerol and fatty acid, whilst one molecule of triglyceride is still intact, or passes through the first phase. Therefore, on bringing about hydrolysis very rapidly, we cannot always observe experimentally the intermediate, transitory phases. If, however, hydrolysis (saponification) be effected somewhat slowly, we shall be able to find in the partially saponified mass : (1) unsaponified triglyceride, (2) diglyceride, (3) monoglyceride, (4) glycerol (glycerin), and (5) free fatty acids.

Now if a large quantity of fat is boiled up, say with caustic soda, in an open soap pan, a sample taken out of this pan before the saponification has been completed will contain all these glycerides. In the present state of our chemical knowledge it is very difficult, if not practically impossible, to separate substances so closely allied. I therefore tried to prove the presence of these intermediate glycerides in an indirect manner.

If monoglycerides and diglycerides were present, then it should be possible to convert them again into a triglyceride by combining them with a suitable fatty acid radicle. If, for instance, a diglyceride be heated with acetic anhydride, then a mixed triglyceride will be formed, of which two radicles are the same as before, whilst the hydrogen of the OH group is replaced by the radicle of acetic acid. Similarly, in a monoglyceride the two hydrogen atoms of the OH groups will be replaced by two radicles of acetic acid. Now the radicle of acetic acid can easily be split off again, and determined by quantitative methods. The amount of the acetic acid we thus obtain is a measure—not an absolute measure, but still a measure—of the amount of mono- or di-glycerides that are present in the sample.

The manner in which the experiments have been carried out cannot be explained here.* It must suffice to state that the amount of

* Compare Lewkowitsch, "Chemical Technology and Analysis of Oils, Fats, and Waxes," Macmillan and Co., 1904, p. 268.

acetic acid is expressed in terms of potassium hydrate with which it combines to form potassium acetate, and that the number so found is termed in fat analysis, the "acetyl value."

If saponification took place exclusively in the manner indicated by equation (2)—*i.e.*, if the glycerides are hydrolysed straightway into fatty acids and glycerol (glycerin) — then samples taken at any intermediate stages of saponification before the completion of hydrolysis should exhibit no acetyl value, but if there be present mono- and di-glycerides, then the samples taken must show a distinct acetyl value.

I have tested these views experimentally by saponifying tallow and cotton seed oil in the laboratory on a somewhat large scale, exactly simulating the operations taking place in a chemical works. Care was taken to conduct the saponification somewhat slowly, so as the more readily to get hold of the intermediate products.

In the following four tables, I present a selection from a large number of experiments I have carried out, saponifying slowly the fatty substance, and examining samples taken out from time to time, whilst the mass underwent hydrolysis (saponification).

TABLE V.—Saponification of Tallow with Caustic Soda (Lewkowitsch).

Partially Saponified Tallow.	Acid Value.	Acetylated Product.		
		Acetyl Value.	Hehner Value.	Saponification Value.
Sample No. 1	12·2	17·1	94·4	207·9
„ „ 2	12·8	24·3	94·7	210·2
„ „ 3	20·9	18·9	94·9	206·6
„ „ 4	31·4	9·7	95·8	203·1
„ „ 5	45·4	15·3	96·0	208·15
„ „ 6	77·9	11·2	97·0	206·7
„ „ 7	105·8	52·03	..	237·65
„ „ 8	126·8	65·6	..	252·5
„ „ 9	145·3	78·9	..	269·0
„ „ 10	152·4	61·8	..	252·7
Fatty Acids, obtained with Alcoholic Potash, Acetylated	..	8·8	99·5	212·8

TABLE VI.—Saponification of Tallow with Lime (Lewkowitsch).

Partially Saponified Tallow.	Acid Value.	Acetylated Product.		
		Acetyl Value.	Hehner Value.	Saponification Value.
Sample No. 1	20·6	13·9	93·3	210·05
„ „ 2	40·9	22·3	93·5	215·3
„ „ 3	79·0	16·6	93·5	214·6
„ „ 4	46·1	15·7	94·5	212·3
„ „ 5	50·98	27·9	93·87	221·4
„ „ 6	59·6	28·0	93·6	223·75
„ „ 7	114·2	..	94·97	216·5
„ „ 8	122·05	27·2	95·5	226·7
„ „ 9	110·9	42·0	93·8	239·35
„ „ 10	128·4	..	95·57	218·7
Fatty Acids, obtained with Alcoholic Potash, Acetylated	..	6·7	99·5	212·8

TABLE VII.—SAPONIFICATION OF COTTON SEED OIL WITH CAUSTIC SODA (Lewkowitsch).

Partially Saponified Oil.	Acid Value.	Acetylated Product.		
		Acetyl Value.	Hehner Value.	Saponification Value.
Sample No. 1	1·63	14·15	..	..
" " 2	3·4	25·9	..	221·7
" " 3	18·4	27·3	..	226·7
" " 4	39·7	21·6	..	232·85
" " 5	45·3	29·8	..	222·65
" " 6	57·0	29·5	..	231·4
" " 7	71·8	25·0	..	225·3
" " 8	95·5	20·8	..	223·8
" " 9	108·2	25·85	..	235·0
" " 10	113·7	22·4	..	221·2
" " 11	161·0	21·7	..	219·9
Original Oil, Acetylated	..	15·8	..	..
Fatty Acids, obtained with Alcoholic Potash, Acetylated	201·2	17·9	..	..

TABLE VIII.—SAPONIFICATION OF COTTON SEED OIL WITH LIME (Lewkowitsch).

Partially Saponified Oil.	Acid Value.	Acetylated Product.		
		Acetyl Value.	Hehner Value.	Saponification Value.
Sample No. 1	0·5	14·9	94·5	206·3
" " 2	0·6	20·0	92·84	209·2
" " 3	16·0	43·15	92·0	230·1
" " 4	17·6	59·2	89·1	240·0
" " 5	19·9	28·3	92·35	215·3
" " 6	53·4	24·9	93·8	214·8
" " 7	73·2	32·4	93·6	223·4
Original Oil, Acetylated	0·0	11·7	93·5	..
Fatty Acids, obtained with Alcoholic Potash, Acetylated	199·45	13·8	99·4	216·4

The first column of Table V. gives the order in which the samples were taken.

In the second column the progress of saponification is indicated. A completely saponified sample would have shown the figure of about 200.

Here we are interested only in the column headed "Acetyl value." The original fat showed in a blank test (which must be carried out for the sake of comparison) an acetyl value of 8·8, and if saponification had not taken place in stages, all samples of the partially saponified mass should have given the same value, viz., 8·8. A glance at the tables proves that widely deviating numbers were obtained. At the same time it will be noticed that the numbers do not vary in a regular manner, but in zigzag fashion. This proves that all the reactions indicated by the above-given equations (2a, 2b, 2c) are taking place simultaneously.

Tables VI., VII., VIII. demonstrate the same fact. The experiments detailed in Table No. VI., represent the process carried out in the old candle-making processes (see Lecture IV.).

In Table No. VII., which illustrates the saponification of cotton seed oil with caustic soda, the zigzag-like progress of saponification is not so distinctly pronounced as in the aforementioned cases, no doubt owing to the saponification having occurred somewhat rapidly

so that all phases seem to have taken place more or less at the same time. On retarding the rapidity of saponification, as shown in Table VIII., when cotton seed oil was saponified with lime and the samples were taken out in somewhat rapid succession (for the last sample had only the acid value 73·2, which means that about 36 per cent. of fat only had been saponified completely), the successive stages become again noticeable. The irregularly moving acetyl values, culminating in the number 59, prove that saponification had taken place in consonance with my views.

The numbers contained in columns 4 and 5 headed "Hehner Value" and "Saponification Value" respectively demonstrate the same law.

[A number of lantern slides were then shown, in which the results were expressed graphically by means of curves.]

Hitherto, I have considered *water* only as the means employed for breaking up the molecule of glycerides, or, to use the scientific term, for "hydrolysing" the glycerides. Since it has been proved experimentally that if water be absent hydrolysis cannot occur, we must accept the view, which I consider the correct one, that water is the hydrolysing agent. It would then follow that those reagents which are employed on a large scale for saponification, such as lime and the caustic alkalis, only act as catalysing agents in that they accelerate the reaction which takes place when oils and fats are hydrolysed by means of water.

As we shall see in the next lecture, it is indeed possible to saponify fats by water alone. Here I wish to lay stress on the fact that water is the hydrolysing agent, and that water alone is capable of effecting hydrolysis if sufficient length of time be allowed. This is proved for instance by the fact that if fats are exposed to the action of moisture (the atmosphere), hydrolysis will gradually set in. Of course, such hydrolysis takes place at a very slow rate only, and may require many years for its completion, much as the decomposition of felspar requires centuries for its completion. This slow process of hydrolysis is well known. It is expressed in common parlance by the word "rancidity," although this term also includes the further subsequent changes which the fatty acids, set free by the spontaneous hydrolysis,* undergo.

From a practical point of view, it is therefore necessary to assist the reaction by suitable agents, so that it may be completed within a short time. In order to understand better the practical processes that will be detailed in the next lecture, it will be advisable to consider and follow here, step by step, from a theoretical point of view the influence of these factors and reagents which are used on a large scale to accelerate the hydrolysing action of water.

To begin with, high temperature is capable of accelerating hydrolysis. If we heat fats with water to a temperature of 200-300°C., the hydrolysis into fatty acids and glycerol (glycerin) will take place within 8 to 10 hours. The comparative rapidity with which the reaction proceeds must be ascribed to some extent to the thorough intermixture between fat and water, since by pulverising the material a very large surface can be exposed to the action of the water.

Another means of accelerating the hydrolysing action of water is *hydrochloric acid*, which obviously does not take part in the chemical change. This is clearly shown by a number of experiments which I have carried out. They are reproduced in the following three tables:—

* I have suggested for this chemical change the term: "Auto-hydrolysis" (see Lewkowitsch, "Chemical Technology and Analysis of Oils, Fats and Waxes," 1904, p. 23).

TABLE IX.—HYDROLYSIS OF OILS AND FATS BY MEANS OF HYDROCHLORIC ACID, SPECIFIC GRAVITY 1·16 (Lewkowitsch).

100 grms. of Oil or Fat boiled with 100 c.c. of Acid.

Oil or Fat.	Original Acid Value.	Acid Value after 24 hours' boiling.	Acid Value of completely Hydrolysed Oil or Fat.
Cotton seed	0·35	143·9	202
Whale	6·01	157·3	195
Rape	2·16	131·7	185
Lard	1·25	140·3	201
Tallow	11·15	150·0	200
Cocoanut	18·75	204·9	260
Castor	1·22	49·14	190

TABLE X.

HYDROLYSIS OF OILS AND FATS BY MEANS OF HYDROCHLORIC ACID, SP. GR. 1·16 (Lewkowitsch).
100 grms. of Oil or Fat and 100 c.c. of Acid ; fresh acid used after each sample had been taken.

Oil or Fat.	Original Acid Value.	Acid Values after										Acid value of completely hydrolysed Oil or Fat
		2 hrs.	7 hrs.	9 hrs.	12 hrs.	14 hrs.	16 hrs.	18 hrs.	20 hrs.	22 hrs.	24 hrs.	
Cotton seed	0·35	18·42	79·6	95·51	116·2	136·4	144·9	155·7	164·8	168·2	175·8	202
Whale	6·01	26·69	101·3	120·3	142·7	155·4	162·3	170·0	172·0	...	...	195
Rape	2·16	19·66	75·06	89·57	107·2	120·1	127·3	134·2	140·3	144·0	151·8	185
Lard	1·25	14·51	84·78	116·8	139·8	149·4	152·1	162·7	168·0	173·0	177·0	201
Tallow	11·15	43·39	112·5	131·7	153·2	167·0	173·3	178·9	183·3	185·2	186·8	200
Cocoanut	18·75	79·73	184·2	210·5	221·4	230·8	233·4	239·8	241·1	246·1	250·1	260
Castor	1·22	44·4	47·3	49·0	51·4	51·4	47·9	49·2	46·8	44·4	41·64	190

TABLE XI.

HYDROLYSIS OF OILS AND FATS BY MEANS OF HYDROCHLORIC ACID, SP. GR. 1·16 (Lewkowitsch), 100 grms. of Oil or Fat, containing Free Fatty Acids, and 100 c.c. of Acid; fresh acid used after each sample had been taken.

Oil.	Original Acid Value.	Acid Values after										
		2 hrs.	4 hrs.	7 hrs.	9 hrs.	12 hrs.	14 hrs.	16 hrs.	18 hrs.	20 hrs.	22 hrs.	24 hrs.
Cotton seed	10·51	37·69	71·1	88·73	94·85	103·9	113·6	117·1	110·7	125·6	132·1	140.3
Whale	15·16	41·44	85·84	105·0	123·2	147·3	158·6	164·3	173·9	175·3	...	...
Rape	9·17	32·1	61·31	75·36	78·09	92·55	101·4	110·1	128·9	132·6	139·6	145·2
Lard	11·3	14·52	49·58	71·46	86·36	101·2	116·8	128·5	138·0	147·3	148·7	155·0
Tallow	20·14	49·41	114·9	140·7	154·5	167·6	175·8	178·6	182·9	183·3	189·0	189·4
Castor	10·98	46·8	50·9	46·8	47·4	47·9	48·5	48·4	46·8	43·3	47·11	48·34

The acid values given in the preceding tables show that hydrolysis becomes very much slower, when about 75 per cent. of the neutral fat has been hydrolysed. The fact that, under the conditions of the experiment, it was very difficult to keep up a thorough intermixture of fat and acidulated water, satisfactorily explains the slowing down of the reaction. It may be safely assumed that provided a thorough intermixture could be brought about, as is the case in an emulsion, hydrolysis would proceed much more rapidly. For the catalytic action of hydrochloric acid is exerted even at the ordinary temperature in course of time, as I have proved by some laboratory experiments.*

Much better results are obtained if *concentrated sulphuric acid* is used as the catalysing agent, for the reason, as I venture to think, a much better emulsion is produced.

To illustrate this by figures, I give in the following table a number of experiments which I have carried out :—

* Lewkowitsch. "Chemical Analysis and Technology of Oils, Fats, and Waxes," Macmillan and Co., London 1904, p 43.

TABLE XII.

HYDROLYSIS OF TALLOW, CONTAINING 6·2 PER CENT. FREE FATTY ACIDS, WITH 4 PER CENT. OF SULPHURIC ACID OF VARYING STRENGTH (Lewkowitsch).

Sulphuric Acid containing per cent. SO_4H_2.	Per cent. Fatty Acids. After steaming for hours																					
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
98	42·1	65·1	79·3	83·7	88·6	91·7	91·7	92·3	93·0	92·3	93·0	93·6	93·6	93·0	93·6	93·6						
90	37·2	47·7	57·6	65·1	72·5	76·0	80·0	81·8	83·6	86·2	88·0	86·8	88·6	88·6	89·0	90·5	90·5					
85	34·1	45·2	50·8	62·6	68·2	73·1	75·0	76·2	79·4	84·3	84·9	89·3	89·3	89·3	89·9	89·9	89·9					
80	31·6	45·2	57·6	65·1	73·1	75·4	79·3	80·6	83·7	85·5	87·4	88·6	89·0	89·9	89·9	89·9						
70	15·5	16·7	17·9	18·3	18·6	20·3	24·8	26·5	28·5	31·0	32·6	34·7	35·4	37·0	39·0	40·1	42·7	45·2	46·5	47·7	47·7	47·7
60	6·2	6·2	6·2	6·2																		
50	6·2	6·2	6·2	6·2	6·8																	

A still better emulsion is produced when Twitchell's reagent (the "sulpho-aromatic" compound prepared by allowing an excess of sulphuric acid to act on a solution of oleic acid in aromatic hydrocarbons) is used. By adding 1 to 2½ per cent. of this reagent to a fat practically complete hydrolysis will be reached on heating the fat in a current of steam, especially in the presence of a few per cent. of free fatty acids, which have been found to influence favourably the starting of hydrolysis.

This is shown by a number of experiments I have carried out. The results are reproduced in table XIII. :—

I have endeavoured to show that the chemical reagents considered hitherto act as accelerators, and I have laid stress on the emulsifying action produced by them.

Now, the most thorough emulsion is obtained by the aid of *ferments*. Hence the correctness of the views which I have expounded here would seem to be convincingly demonstrated if ferments did possess the power of hydrolysing oils and fats. This is, inded, the case,

One of the ferments which effects hydrolysis of fats in our own internal economy, *i.e.*, in the digesting process of fats, is "steapsin." In a number of experiments I made in collaboration with Dr. Macleod I have been able to show that the "steapsin" obtained from the pancreas of the pig is a comparatively powerful fat-hydrolysing ferment. This is demonstrated by the numbers given in table XIV.* :—

More rapidly is hydrolysis brought about by the ferment contained in castor seed and a number of other plant seeds. In table XV. I have collated a number of experiments published by Connstein, Hoyer, and Warten-

* Compare Lewkowitsch and Macleod, "Proceedings Royal Society," 1904, p. 31.

TABLE XIII.—Hydrolysis of Oils and Fats by means of Twitchell's Reagent (Lewkowitsch). 100 grms. of Oil or Fat, steamed up with 1 per cent. of the Sulpho-aromatic Compound in open flasks.

Oil or Fat.	Original Acid Value.	Acid Value after															
		2 hrs.	7 hrs.	9 hrs.	12 hrs.	14 hrs.	16 hrs.	18 hrs.	20 hrs.	22 hrs.	24 hrs.	26 hrs.	28 hrs.	30 hrs.	32 hrs.	34 hrs.	36 hrs.
Cotton seed ...	5·67	8·75	61·28	99·8	129·4	137·6	148·7	150·1	155·9	157·9	161·4	164·5	165·2	166·3	167·0	168·4	168·9
Whale ...	6·01	14·99	48·69	63·72	72·42	80·8	84·31	85·82	89·68	90·71	91·67	91·67	91·7	94·69	97·88	98·07	98·9
Rape	2·16	8·4	23·24	30·59	44·26	50·57	53·6	55·4	56·58	56·72	57·91	59·58	60·6	61·46	61·61	61·87	62·3
Lard	2·6	11·37	38·66	58·73	82·42	90·81	98·49	107·3	107·9	109·0	110·5	112·0	115·2	118·3	118·6	119·1	120·2
Tallow ...	11·15	15·03	25·68	43·44	49·39	50·11	52·03	53·1	53·85	55·6	57·11	59·82	60·23	63·95	66·2	67·3	68·5
Cocoa nut	18·75	114·0	221·4	232·9	233·2	236·0	236·2	237·2	237·9	238·9	239·5	239·8	239·8	240·6	240·9	241·0	241·2

TABLE XIV.—Hydrolysis of Glycerides with the aid of Steapsin Preparations (Lewkowitsch and Macleod).

Preparation.	Cubic Centimetres of Preparation per 100 Grams of Cotton Seed Oil or Lard.	Date on which started.	Added to Emulsion.		Per Cent. of Free Fatty Acids formed.					
			Acid.	Alkali.	Feb. 23	Mar. 2	Mar. 9	Mar. 16	Apr. 16	May 1
Cotton Seed Oil.										
1	20	19/2/03	0	0	22·9	...	43·3	48·4	80·6	...
1	30	19/2/03	0	0	32·8	...	49·9	60·45	86·7	...
1	25	19/2/03	0·5 c.c. of 2 per cent. acetic acid	0	10·22	26·4	41·04	48·8	74·7	...
1	30	19/2/03	0	0·5 c.c. 1/10 norm. NaOH	31·25	39·5	55·4	63·1	...	...
2	30	5/3/03	0	0	...	...	37·1	44·3	68·3	70·2
2	50	5/3/03	0	0	...	...	32·7	46·4	71·5	83·8
2	60	5/3/03	0	0	...	...	31·03	46·3	60·8	79·5
2	60	5/3/03	0·5 c.c. of 2 per cent. acetic acid	0	...	...	30·4	45·2	65·3	73·7
2	60	5/3/03	0	0·5 c.c. 1/10 norm. NaOH	...	...	36·5	44·9	66·4	73·5
2	30	5 3/03	0	1 c.c. 1/10 norm. NaOH	...	...	31·4	43·8	74·1	74·3
2	50	5/3/03	1 c.c. of 2 per cent. acetic acid	0	...	...	37·66	44·5	65·2	77·2
Lard.										
2	50	5/3/03	0	0·5 c.c. 1/10 norm. NaOH	...	...	8·98	9·2	29·9	46·7
2	80	5/3/03	0	1 c.c. 1/10 norm. NaOH	...	...	12·2	14·4	20·7	22·9

burg, which prove the feasibility of hydrolysing oils and fats by means of water if its action be assisted by the ferment contained in castor seed, and a small quantity of dilute acid be admixed as an additional accelerator.

Another class of accelerating agents, employed in practice on a very large scale, are *basic materials*, such as calcium oxide, magnesium oxide, and especially the caustic alkalis. Now, if the view that the bases act as accelerating agents (in other words as catalysts) be correct, then it should not be imperative that the bases be present in at least molecular proportion to the fatty acids which will be liberated when the hydrolysis becomes complete. The greater the amount of the bases present, the more rapidly should the resolution of the glycerides into their component parts take place, and the greater should be the amount of salts of the fatty acids formed; but a deficiency in the amount of the bases required to neutralise all the fatty acids obtainable by complete hydrolysis should not preclude the completion of the hydrolysis.

Since the rapidity of saponification stands in direct ratio to the quantity of the bases, it will be possible, by using an excess of bases, to lower the temperature otherwise required for effecting hydrolysis, and to shorten the time within which it is practically completed. These points are clearly brought out in the technical process of saponification by means of lime. The quantity of lime requisite for the neutralisation of the fatty acids produced on completely hydrolysing a glyceride can be calculated from the following summarising equation:—

$$2\ C_3H_5\begin{matrix}O.R\\O.R\\O\ R\end{matrix} + 3\ Ca\ (OH)_2 = 2\ C_3H_5\begin{matrix}O.H\\O.H\\O.H\end{matrix} + 3\ Ca\ (OR)_2$$

The amount of caustic lime—CaO—required for a triglyceride having the mean molecular weight 860, is 9·7 per cent., but even prolonged boiling with steam in an open vessel with this amount of lime will not lead to complete saponification. Unless the proportion of caustic lime be raised to 12-14 per cent., the hydrolysis of the glyceride cannot be brought to an end in an open vessel, *i.e.*,

TABLE XV.—HYDROLYSIS OF OILS AND FATS BY MEANS OF THE CASTOR SEED FERMENT.

Oil or Fat.	Grms.	Castor Seed. Raw.	Castor Seed. Extracted.	Fatty Acids formed. Per cent.	After Hours.	Temperature.	Acid.
		Grms.	Grms.			°C.	Grms. $n/10\ SO_4H_2$
Tallow	6·5	5	..	72	19	35	4 ,, ,,
Bone fat	6·5	5	..	81	19	35	4 ,, ,,
Cotton seed oil	6·5	5	..	84	19	35	4 ,, ,,
Palm oil	6·5	5	..	87	19	35	4 ,, ,,
Rape oil	6·5	5	..	84	19	35	4 ,, ,,
Palm nut oil	16·5	5	..	76·6	20	Ordinary	8 ,, ,,
Arachis oil	25	..	1·3	100	96	,,	5 ,, ,,
Rape oil	25	..	..	100	96	,,	5 ,, ,,
Poppy seed oil	25	..	..	100	96	,,	5 ,, ,,
Linseed oil	50	..	5	83	24	,,	10 ,, ,,
Blubber oil (I.)	50	..	5	76	24	,,	10 ,, ,,
,, ,, (II.)	50	..	5	84	24	,,	10 ,, ,,
Olive oil	50	..	5	86	24	,,	10 ,, ,,
Sesamé oil	50	..	5	85	24	,,	10 ,, ,,
Almond oil	50	..	5	90	24	,,	10 ,, ,,
Cacao butter	50	..	5	92	24	,,	10 ,, ,,
Palm oil	75	..	7·5	77	6	,,	15 ,, ,,
,, ,,	75	..	7·5	96	22	,,	15 ,, ,,
Cotton seed oil	75	..	1·5	82	44	,,	15 ,, ,,
,, ,,	100	..	5	87	44	,,	10 ,, ,,
,, ,,	75	..	7·5	79	24	,,	15 ,, ,,
Triolein	10	..	..	50·6	24		
Triacetin	10	..	0·5	0·4	24		2 ,, ,,
Tributyrin	10	..	..	9·5	24		

at a temperature of 100-105° C. If, however, the temperature be raised (as is done on a large scale by treating fats with milk of lime in an autoclave under pressure), the proportion of caustic lime can be greatly reduced until, at a pressure of 12 atmospheres corresponding to a temperature of 220° C., even 1 per cent. of lime suffices to effect complete hydrolysis. Although the glyceride is completely hydrolysed, yet only so much of the fatty acid is neutralised by lime, *i.e.*, converted into lime soap, as is chemically equivalent to the quantity of lime employed.

The same considerations—*mutatis mutandis*—hold good if caustic alkalis are used as accelerators. In the last case, hydrolysis proceeds much more rapidly, inasmuch as, in contradistinction to the process of hydrolysis assisted by lime, a water-soluble soap is formed, which helps to emulsify the fat.

In the next lecture we shall see how far the practice of manufacturing processes bears out the correctness of these theoretical considerations.

Miscellaneous.

*THE INFLUENCE OF AGRICULTURAL IMPROVEMENTS ON RENT.**

The reprinting of Malthus's pamphlet on "The Nature and Progress of Rent" has suggested the comparison of his conclusions with those suggested by a study of rent diagrams. In the paper the integral diagram is employed—that is, the abscissæ represent outlay on cultivation; the corresponding ordinates represents the total return secured.

Three cases are examined: (1) Effect of a change of value of agricultural produce; (2) effect of changes of method, increasing in the same proportion the return to all outlay on cultivation; (3) effect of changes which increase the return to some scales of cultivation and diminish those to others. Decreasing returns are assumed throughout.

In the first case a rise of price yields increase of rent generally, though on the question of the proportion which rent bears to total produce the result may vary with the intensity of cultivation. The second case is but the first under another form. In the third case there cannot be stated any general rule as to the direction of change. The combination of the second and third cases will give the most general case. The conclusion that improvements tend in all cases to increase the proportion which rent bears to total produce, appears not to be supported by the presentation of the case in diagrammatic form.

* Abstract of paper read by A. W. Flux, M.A., before Section F of the British Association at Cambridge.

Obituary.

Major-General Webber, C.B.—The Society of Arts has lost an old and prominent member in the person of General Charles Edmund Webber, who died on Friday, 23rd inst. He was born on September 5th, 1838, the son of the Rev. T. Webber, of Leekfield, county Sligo. After passing through the Royal Military Academy, Woolwich, he obtained his commission in the corps of Royal Engineers in 1855. During the Indian Mutiny he was present at the siege of Chandaree, the siege and storming of Jhansi, the battle of Betwa, and the action at Koonch. From 1861 to 1866 he was Assistant-Professor of Surveying and Topography at the Royal Military Academy, Woolwich, and from 1870 to 1879 he was an officer of the Postal Telegraph Department and had much to do with the extension of the telegraph system. In 1879 he accompanied Viscount Wolseley (then Sir Garnet Wolseley) to South Africa as Assistant Adjutant and Quartermaster-General, and took part in the Zulu campaign, and also in the operations against Sekukuni in the Transvaal, being again mentioned in despatches, and receiving the medal with clasp. In the Egyptian expedition of 1882 General Webber held a similar position—namely, that of Assistant Adjutant and Quartermaster-General at Headquarters, and was in charge of the telegraph lines. He was present at the battle of Tel-el-Kebir, and was again mentioned in despatches, receiving the medal with clasp and the bronze star. At the same time, he was made a C.B. He was up the Nile again in 1884-5 with the Sudan expedition, and added a clasp to his Egyptian medal. This brought his active military career to an end, as he retired in July, 1883. General Webber was elected a member of the Society of Arts in 1874, and was a Member of Council in 1878, 1880, 1881, and 1884. He was a member of the Committee appointed to make arrangements connected with the Society's offer of prizes, in 1872, for improved stoves, and in consequence of having made tests previously, at Paris, he was asked to form a series of directions for testing the competing stoves. He read several papers at the evening meetings, which are published in the *Journal*, on "Telephonic Communication" (April 26th, 1882), "Telegraph Tariffs" (May 21st, 1884), "Glow Lamps; their Use and Manufacture" (December 8th, 1886). General Webber was the founder, with the late Sir Francis Bolton, of the Institution of Electrical Engineers, and was a past president of that Society. In 1867, he was attached to the British Commission for the Paris Exhibition. He was a Juror for Telegraph Apparatus at the Paris Exhibition of 1878, one of the British Commissioners for the Paris Electrical Exhibition of 1881, and a Juror at the International Health Exhibition in 1884. He was a director and engineer of various electrical companies.

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

CANTOR LECTURES ON ELECTRO-CHEMISTRY.

Mr Bertram Blount's Cantor lectures on "Recent Advances in Electro-Chemistry" have been reprinted from the *Journal*, and the pamphlet (price one shilling) can be obtained on application to the Secretary, Society of Arts, John-street, Adelphi, London, W.C. A full list of the Cantor lectures which have been published separately, and are still on sale, can be obtained on application to the Secretary.

Proceedings of the Society.

CANTOR LECTURE.

OILS AND FATS—THEIR USES AND APPLICATIONS.

By Dr. J. Lewkowitsch, M A., F.I.C.

Lecture IV.—Delivered February 15th, 1904.

In the last lecture we have dealt with the theory underlying the hydrolysis of oils and fats, and I there advanced the view that the splitting up of the fat molecule into its constituents is effected solely by means of water assisted by certain accelerators. To-night we shall descend from the blue sky of theory to the solid ground of fact, and consider how far these theoretical views are borne out in practice by those manfacturing processes that are in vogue at present.

Candle Industry.

I have shown that water alone, at high temperatures, is capable of effecting hydrolysis, according to the equation :—

$$C_3H_5\begin{matrix}O.R\\O.R\\O.R\end{matrix} + 3\ H_2O = C_3H_5\begin{matrix}O.H\\O.H\\O.H\end{matrix} + 3\ R.OH$$

This reaction can be realised in practice, and has indeed been carried out on a large scale by heating fats with water at high temperatures. The first attempt to work such a process on an industrial scale was made 50 years ago by R. A. Tilghmann, whose method consisted in forcing an emulsion of fat and water through an iron tube heated in a furnace to a temperature of about 330° C. This process, the plant for which I show in a lantern slide, possesses only historical interest to-day, for it was soon abandoned on account of the incomplete saponification and of the destruction of fatty material at the high temperature.

Since the employment of free fire involves the danger of burning the fat, the efforts of later inventors have been directed to carrying out the hydrolysis by means of water in an autoclave. These efforts have met with greater success. From the following table (Table XVI.), it will be gathered that, with the increase of pressure under which water acts on the glycerides, or, in other words, with the increase of temperature of the heating steam, the rate at which hydrolysis takes place is much increased. In practice, steam at a pressure of 15 atmospheres = about 220 lbs. per square inch (corresponding to a temperature of about 200° C.) is capable of effecting hydrolysis to a very high extent.

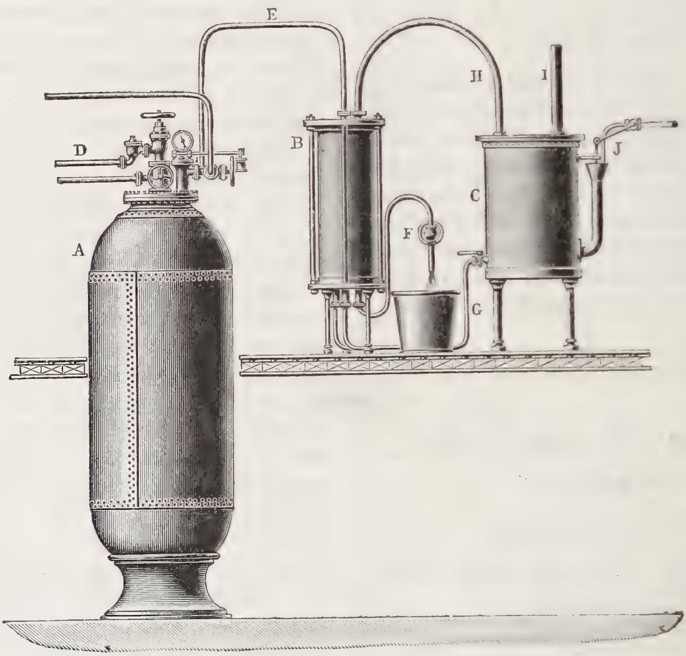
An apparatus worked on a practical scale is Hughes' apparatus (Fig. 10), which I saw in operation in a Paris factory fifteen years ago. The fat is charged into the autoclave A, about 30 per cent. of water are added, and steam, generated in a multi-tubular boiler at a pressure sufficiently high to keep up a working pressure of 15 atmospheres in the apparatus, is sent into the autoclave. The steam is finely divided into streamlets by a distributor similar to the one shown in Fig. 14. In order to provide additional security, beyond that afforded by the safety valve, against explosion, and in order thoroughly to agitate the mass, a small amount of steam is allowed to escape continuously through the pipe E, which thus serves as an extra safety valve. The escaping steam is made use of for the concentration of a glycerin solu ion charged (through pipe G),

TABLE XVI.—AQUEOUS SAPONIFICATION OF NEUTRAL FATS UNDER PRESSURE.

30 grms. of Oil or Fat and 300 grms. of Water.

Kind of Oil or Fat.	At a pressure of Seven Atmospheres. Acid values after				At a pressure of Fifteen Atmospheres. Acid values after			
	2 hrs.	4 hrs.	6 hrs.	8 hrs.	1½ hrs.	2 hrs.	4 hrs.	6 hrs.
Cocoanut Oil	0·1	0·3	0·5	0·9	78·6	90·2	123·9	185·5
Japan Wax	4·8	5·3	9·4	13·1	..	12·3	32·5	46·1
Tallow	17·5	37·3	67·3	84·8	..	62·3	106·3	155·8
Pressed Tallow..	15·3	38·3	65·5	81·6	..	60·4	98·7	160·3
Cocao Butter	12·3	24·5	41·1	62·6	..	34·5	76·1	160·5
Olive Oil	15·1	32·1	53·0	71·4	..	66·5	114·5	159·5
Sesamé Oil	14·3	31·1	56·2	76·0	..	61·7	108·4	153·7
Cotton Seed Oil	10·0	23·2	36·3	51·7	..	42·2	80·2	128·6
Linseed Oil	11·4	21·1	43·3	56·1	..	38·1	78·5	130·5

FIG. 10.



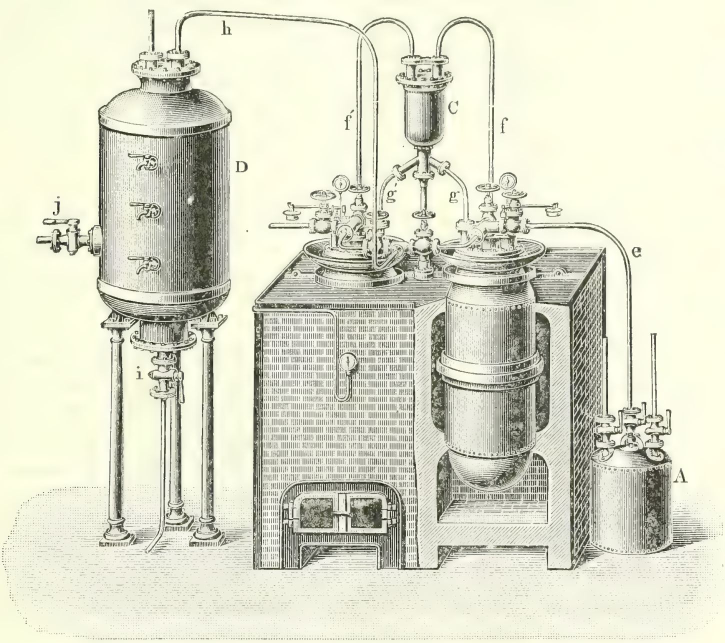
into vessel B, in which is enclosed a heating coil connected with E; the condensed water escapes through valve F, which latter acts as a kind of steam trap. The steam evolved from the glycerin solution in B, serves to pre-heat a dilute glycerin solution fed into vessel C at J. In consequence of the high temperature, the material in the autoclave becomes seriously discoloured, so that the fatty acids must be chiefly worked up by the "mixed process" (see below). Moreover, since the hydrolysis of the fat does not reach so high a percentage as is the case in the processes of saponification with the assistance of bases, a small percentage of lime, about 1 per cent., is usually added to the mass into the autoclave. Hence, practically speaking, this method approaches very nearly the one applied in the lime saponification process.

The saponification is not only accelerated by the high temperature, but also by the thorough emulsion that is produced by violent agitation. In order to produce a still more thorough intermixture between fat and

water, Michel designed the apparatus shown in Fig. 11. A pair of autoclaves is worked conjointly. They are charged through the pressure vessel, A, and pipe *e* with fat and water. The autoclaves are heated by fire, and as the pressure rises the contents of the autoclaves are forced up through the tubes, *f f'*, which reach almost to the bottom of the autoclaves, into the top of the mixing vessel C, whence the mass falls back again into the autoclaves. The mass, somewhat cooled in C, falls to the bottom of the autoclave through the hot mass therein, thus contributing to the thorough intermixture of fat and water. This play repeats itself, whilst the pressure on the autoclaves is kept up at 15 atmospheres for eight hours. The hydrolysed mass is then forced through pipe *h* into the vessel D, in which separation into two layers—an upper layer of fatty acids and a lower layer of glycerin water ("sweet water")—takes place. The heating of the autoclave by direct fire is, however, a serious drawback of the process, as it may possibly lead to burning of the fat. Therefore, Michel's method is less acceptable than Hughes's. The autoclaves were shown at the Paris Exhibition of 1889, but, as far as I am aware, the process has not been adopted in Europe.

Since the pressure and the temperature of steam stand in a definite relation to each other, it follows that high pressure steam may be replaced by superheated steam standing under ordinary pressure. Hence hydrolysis should become feasible by treating fats with superheated steam at a sufficiently high temperature. A process based on the hydrolysis by means of steam under the ordinary pressure was patented as early as the year 1825 (Eng. Pat. No. 5183, 1825), but it did not gain practical importance until Wilson and Payne took their patent for "Improvements in distilling fatty and oily matters" (Eng. Pat. No. 1624, 1854).

FIG. 11.



In their process, glycerides were heated in a still, whilst superheated steam was sent through the fatty mass, the temperature of which was kept between 550° and 600° F. The products of hydrolysis, viz., the fatty acids and glycerol (glycerin), were carried over by the water vapours. The apparatus employed was similar to the one illustrated in Fig. 13. (p. 838). Although this process is stated to have been worked for a number of years, it has been abandoned, since considerable quantities of fatty matter underwent destruction. I endeavoured (Eng. Pat. No. 5985, 1888) to render practicable this mode of hydrolysing fats by heating them in a current of superheated steam *in vacuo*. Also this process proved unremunerative, and was therefore abandoned.

In the processes described hitherto the intermixture between fat and water is perhaps not a sufficiently intimate one; hence a somewhat long time is required for the completion of the reaction. If a thorough emulsion could be kept up at that high temperature, it should be feasible to carry out the process in a shorter time. As an example of the beneficial effect of a thorough emulsion, I may point to that produced by ferments, especially by castor seed ferments. The results obtained in a series of laboratory experiments with the latter ferment have been given already in table No. XIV. (Lecture III. p. 831.). These results appeared sufficiently encouraging to propose the process as a manufacturing operation. This is conducted as follows:—The castor seeds, either decorticated or in their original state, are ground up to a fine pulp, and mixed with about 50 per cent. of water, calculated on the quantity of fat to be hydrolysed; this is then thoroughly intermixed with the oil or fat. The emulsion is allowed to stand about two days when the bulk of the fat is found to have been hydrolysed. I show here the product obtained in this manner from cotton seed oil. In this special case hydrolysis amounting to as much as 90 per cent. has been reached. Another example illustrating this process is the product obtained from tallow; here hydrolysis has taken place to the extent of about 80 per cent. only. Evidently tallow does not lend itself to this process as readily as cotton seed oil.

Since practically complete hydrolysis, such as is obtained in the apparatus shown in the last figures is not obtained by this ferment process, it must be considered as useless to the candle-maker, who requires free fatty acids (as we shall see later on). Still, I have particularly mentioned this process as it affords, in my opinion, the best illustration of the view which I have so frequently insisted upon, that water alone, if properly assisted by some accelerator, is capable of saponifying oils and fats.

A less thorough emulsion is effected by means of Twitchell's reagent. The mode of preparing this reagent has been already described in the last lecture, and its action on oils and fats has been illustrated by table No. XIII., p. 830.

I have experimented with a number of "Twitchell's reagents," in which benzene was replaced by naphthalene, anthracene, and phenanthrene. I have found that the best results were obtained by using naphthalene, as can be readily seen from the following tables.

On saponifying on the large scale, it is necessary to start with a fat containing at the outset a few per cent. of free fatty acids, as without this expedient the reaction does not set in rapidly. This process has been introduced in several works in the United States, as it is specially suitable for low class material, which would be too expensive to work up in an autoclave on account of the high percentage of free fatty acids. Moreover, the high percentage of free fatty acids ensures the ready starting of the hydrolysis.

This process differs favourably from the last-mentioned one, in that it is suitable for

TABLE XVII.—Hydrolysis of Cotton Seed Oil by means of 1 per cent. of Sulphostearo-aromatic Compounds (Lewkowitsch).

(a) Neutral Oil.

Sulphostearo-aromatic compound of	Original Acid Value.	6½ hrs.	13 hrs.	19½ hrs.	26 hrs.	32½ hrs.	39 hrs.	45½ hrs.
Naphthalene	1·22	146·7	190·7	201·4	211·4	..	..	..
Anthracene	1·22	2·5	21·8	76·3	170·7	186·5	190·7	..
Phenanthrene	1·22	45·7	125·7	177·7	183·6	194·1	201·2	..

(b) Oil containing Free Fatty Acids.

Sulphostearo-aromatic compound of	Original Acid Value.	6½ hrs.	13 hrs.	19½ hrs.	26 hrs.	32½ hrs.	39 hrs.	45½ hrs.
Naphthalene	8·3	30·9	194·1	216·9	210·7	..	..	..
Anthracene	8·3	15·01	60·5	112·4	147·2	148·2	189·8	202·8
Phenanthrene	8·3	42·3	159·9	156·4	181·6	184·2	204·2	204·2

the candlemaker, as practically complete saponification is reached in the same or even a shorter time than in the ferment process. I show here a sample of tallow fatty acids prepared by the Twitchell process. They are somewhat dark in colour; this accounts for the fact that the fatty acids are not suitable for soap making, at any rate not in this country.

The Twitchell process seems to form a kind of intermediate link between hydrolysis by means of water alone and hydrolysis effected with the assistance of concentrated sulphuric acid. The latter is the well-known acid saponification process which has been practised for many years. I have shown by means of table No. XII. (Lecture III., p 829) how the hydrolysis (saponification) of tallow proceeds if 4 per cent. of concentrated sulphuric acid are employed as an accelerating (emulsifying) agent. This process is easily carried out on the large scale. The fat is freed from water by heating it to 120° C. and mixed with a few per cent. of sulphuric acid for a few minutes at 120° C. in a mixing machine such as is shown in Fig. 12; the whole mass is then run into boiling water and steamed for a certain number of hours, until complete decomposition of the intermediate product is effected. The nature of these intermediate products has not yet been completely investigated. They appear to consist of sulpho-compounds of fatty acids. Whilst the saturated acids, palmitic and stearic acid, are finally recovered, after steaming, as such, the liquid oleic acid is to some extent converted into solid products, so that the yield of candle material from a given fat, in consequence of the conversion of oleic acid into a solid material, is greater than the yield obtained by the saponification we shall consider presently.

The progress of hydrolysis taking place in the course of steaming the mass is illustrated by the following table:—

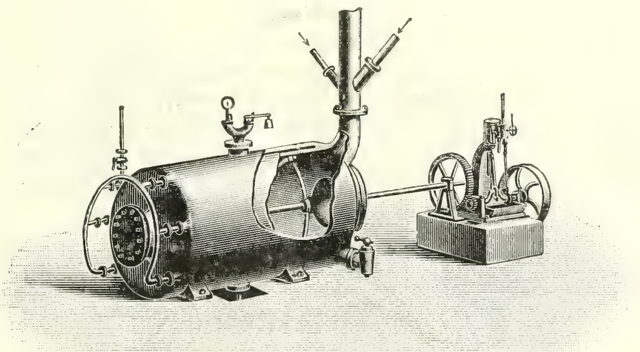
TABLE XVIII.—Tallow Hydrolysed with 4 per cent. of Concentrated Sulphuric Acid at 120° C. (Lewkowitsch).

			Contained Free Fatty Acids. Per cent.
Sample taken after	1 hour's steaming	.. ..	42·1
,, ,,	2 hours'	.. ..	65·1
,, ,,	3 ,,	.. ..	79·3
,, ,,	4 ,,	.. ..	83·7
,, ,,	5 ,,	.. ..	88·6
,, ,,	6 ,,	.. ..	91·7
,, ,,	7 ,,	.. ..	91·7
,, ,,	8 ,,	.. ..	92·3
,, ,,	9 ,,	.. ..	93·0

The product obtained by this process as illustrated here by several samples prepared from various materials, is somewhat dark, but the colour is not of great importance to the candle maker, as he is able to purify the material cheaply, by distillation in a still such as is shown in Fig. 13. The acid-saponification process is especially suitable for working up low-class material, which contains little glycerin, as a certain amount of glycerin undergoes destruction. The loss of glycerin is, however, compensated for by the larger yield of candle material, as pointed out already.

In order to more fully understand this, let us consider tallow, which may be looked upon as consisting of palmitin, stearin, and olein, and let us assume that the yield obtainable from tallow by an autoclave process is 45 to 47 per cent. of palmitic and stearic acids, and 48 or 47 per cent. of oleic acid. The former 45 to 47 per cent. are useful as candle material, whereas the latter 48-47 per

Fig. 12.



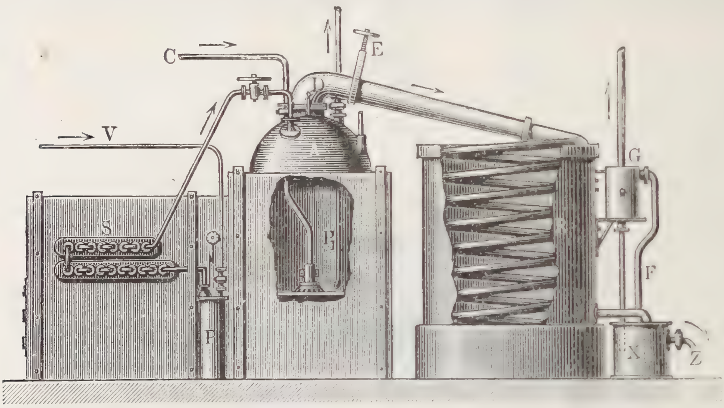
cent. are a by-product which must be disposed of in the best possible manner. Since, however, in the acid saponification process (as mentioned already) a portion of the oleic acid is converted into solid material useful for candle making, the candlemaker would obtain by the acid-saponification process of tallow something like 63 per cent. of candle material, and only 30 per cent. of the less valuable oleic acid.

This explains why the acid saponification process finds wide application, especially so in the case of those fats which are impure and contain a large amount of free fatty acids, so that the yield of glycerin from them would in any case be much smaller than from fresh neutral fats.

actually practiced largely; it is known under the name "mixed process," and may be likened to the "huilerie mixte" we have considered in the first lecture under the production of olive oil. Thus, the mixed process consists in hydrolysing fats in an autoclave, removing all the glycerin formed, and treating the fatty acids with concentrated sulphuric acid so as to obtain the higher yield of 63 per cent. of candle material.

Since for a process of this kind the freshest neutral fats can be used, the hitherto described autoclave processes would appear to be too costly. The endeavour of the candlemaker has therefore been directed to accelerating the process of saponification by such catalysts as we have seen (in the third lecture) to be of

Fig. 13.



Since the yield of glycerin forms a very important item in the economics of any saponification process—especially so to the candlemaker — in contradistinction to the soapmaker—the efforts of the candlemaker have been directed to recovering the full amount of glycerin.

It has been shown that a certain amount of glycerin undergoes destruction in the acid-saponification process, so that even by working it most carefully loss must occur. If we consider that the action of sulphuric acid on oleic acid is practically the same as the action on olein, as regards the obtainment of a high yield of candle material, the most advantageous process would appear *a priori* to be some such one in which the full amount of glycerin is recovered—as in the autoclave processes considered above—and the concentrated sulphuric acid be allowed to act on the *free fatty acids*. A process of this kind is

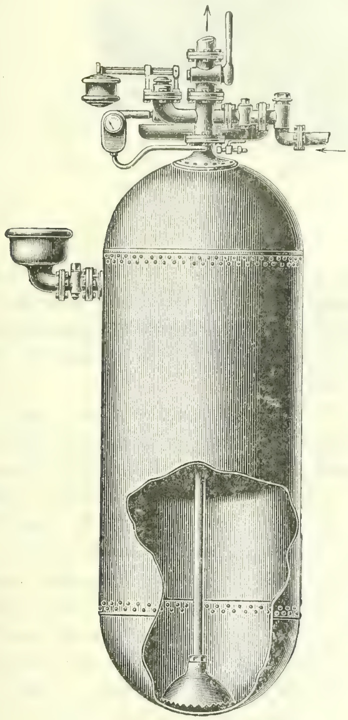
assistance in the saponification in autoclaves, namely, basic substances. Since caustic alkalis are out of the question on account of their cost, the candlemaker uses lime, magnesia, and zinc oxide.

In the oldest process, the one proposed by de Milly, fats were saponified by means of 12–14 per cent. of lime in an open vat, so that the total amount of fatty acids was converted into lime soap. The latter was then decomposed by sulphuric acid in order to liberate the free fatty acids which form the candlemaker's raw material.

We have seen in the last lecture that by increasing the pressure under which hydrolysis is carried out, the proportion of the accelerator may be reduced. Indeed, this is done at present in the well-known process of the candlemaker, who hydrolyses the fats in an autoclave by means of 3 per cent. of lime, under a pressure of 8 atmospheres. The

usual autoclaves are illustrated by Figs. 14 and 15. The autoclave, Fig. 14, consists of a cylindrical vessel made of copper, strong enough to withstand a working pressure of eight atmospheres, and provided with an internal steam pipe, which reaches the bottom of the vessel. In Fig. 14 the steam leaves at the bottom of the serrated cone, and is thus divided into a number of streamlets, which churn the mixture of fat and water into a thorough emulsion. The water and fat, in the proportion of 1 to 3 or 1 to 4, as also the lime, in the form of milk of lime, are fed through the funnel-shaped vessel at the side of the autoclave. In the other form of autoclave illustrated by Fig. 15, the agitation effected by steam is assisted by a mechanical stirring arrangement.

FIG. 14.

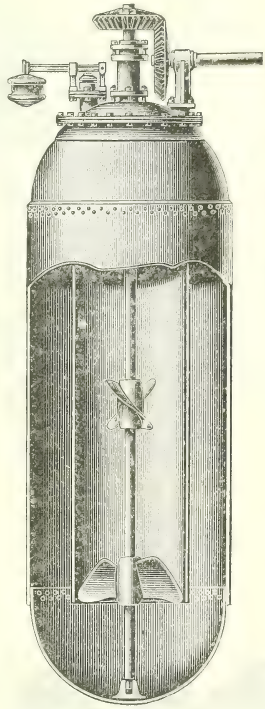


A horizontal form of autoclave, fitted with a stirring arrangement of a different kind is illustrated by Fig. 16. Since the cylindrical autoclaves are liable to be bulged out by high pressure, they would at last, if bulging took place progressively and in a regular manner, assume the shape of a sphere. Hence, also spherical autoclaves are in vogue. An autoclave of this kind, provided with a stirring arrangement, is shown in Fig. 17.

In the processes considered here the hydrolysis reaches as high a figure as 98 or 99 per cent.

When the saponification is deemed complete, the saponified mass is allowed to rest in the autoclave until it has separated into two layers—a lower layer of glycerin water ("sweet water"), and an upper layer of fatty acids, containing so much lime soap as corresponds to the lime introduced into the autoclave. These two layers are either pumped separately into store vats, or in order to save time, the whole mass may be pumped into a settling tank, where the separation into the two layers takes place. The further working up of the glycerin water will be considered below.

FIG. 15.



The fatty material consists of a mixture of solid acids and oleic acid as described already. If best materials have been used, then it is not advisable to acidify the total fatty acids, as obviously the solid acids would merely be carried through the process as so much inert material, and thus increase the cost of the process. In such a case, the oleic acid is separated from the mixed fatty acids by pressure. This is carried out in the following manner:—The mixed

fatty acids after being thoroughly freed from mineral acid, are run into shallow trays arranged in tiers, in which the fatty acids are allowed to crystallise. The temperature at which the crystallisation takes place is carefully regulated, so as to obtain well formed crystals of stearic and palmitic acids embedded in the mother liquor of oleic acid. If the fatty acids are cooled too rapidly, they solidify to an amorphous mass, from which it is extremely difficult satisfactorily to express the oleic acid. The solidified mass is taken out of the trays and pressed, at first at the ordinary temperature in a cold press, such as shown in Fig. 18. The bulk of the oleic acid —"red oil"—is thereby removed. The hard cakes still contain too much oleic acid, and are therefore expressed for the second time, at a somewhat higher temperature, in a hot press (Fig. 19), the cakes being placed in bags of horsehair or other suitable material between two press plates, which are heated by live steam. In the figure shown the steam is supplied from above; but since the stuffing-boxes, owing to the wear and tear to which they are subjected, require frequent renewing, the steam is supplied in more modern presses from below.

FIG. 16.

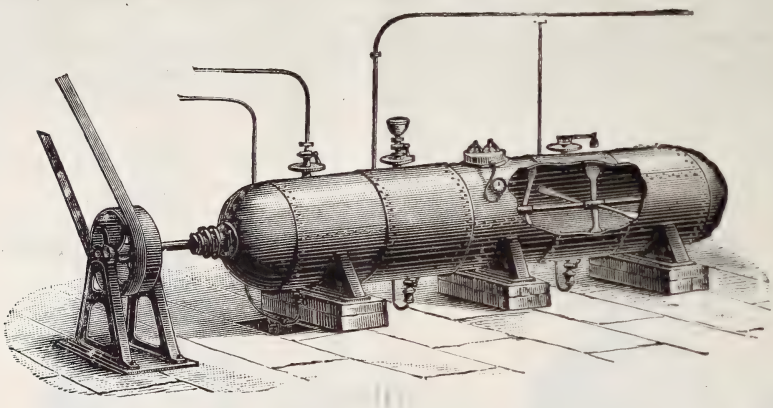
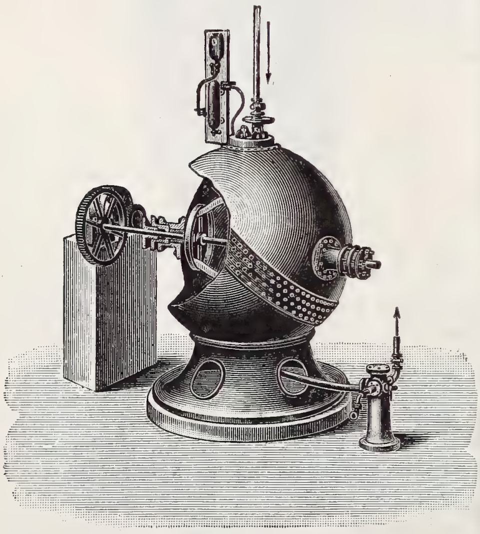


FIG. 17.



The cakes are allowed to stand under pressure in the hot until a sufficient amount of oleic acid has been expressed to leave the cakes white, ready to be melted (after a further purification if required), and to be moulded into candles. The oleic acid which runs from the hot-pressed cakes contains a considerable amount of solid acids—"stearine." These are recovered on a large scale, either by admixing the expressed material with the original fatty acids, or by treating it together with the "red oil" in a refrigerating plant, where the oleic acid is cooled in large tanks either by means of cold brine, or a calcium chloride solution sent through a row of coils in the tank.

A more rapid method of cooling consists in allowing the oleic acid to run over a refrigerating wheel—Petit's wheel (Fig. 20). This is partly shown in section. The cooled brine enters at C, runs along the circumference of the wheel, and leaves at the opposite side. The oleine is fed into trough *f*, into which the refrigerating wheel dips, carrying with it upwards a thin film of oleic acid, which is thus rapidly cooled, and deposits crystals of "stearine." The crystalline mass on reaching the scraper h, is scraped off, and the sludgy

FIG. 18.

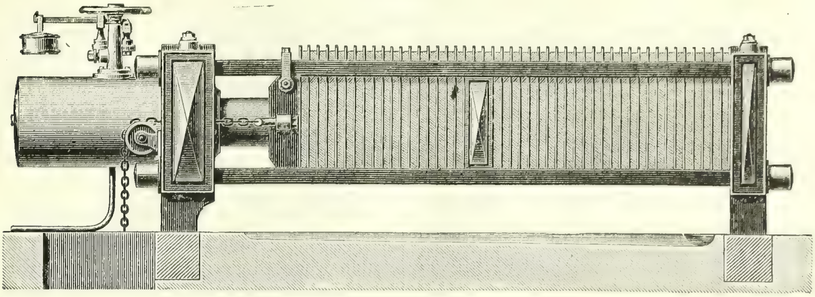


FIG. 19.

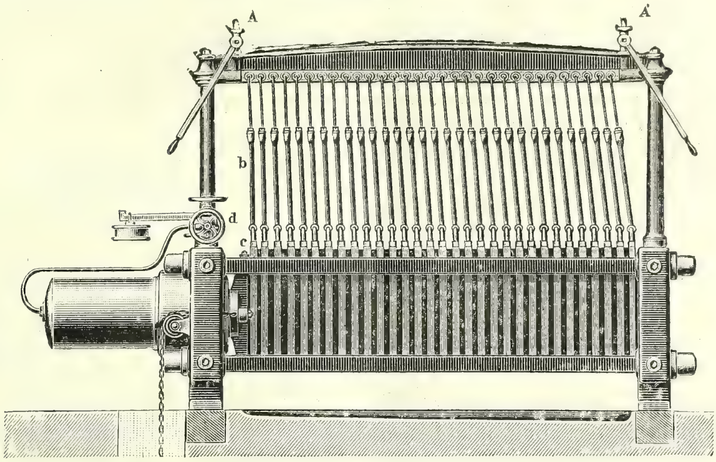
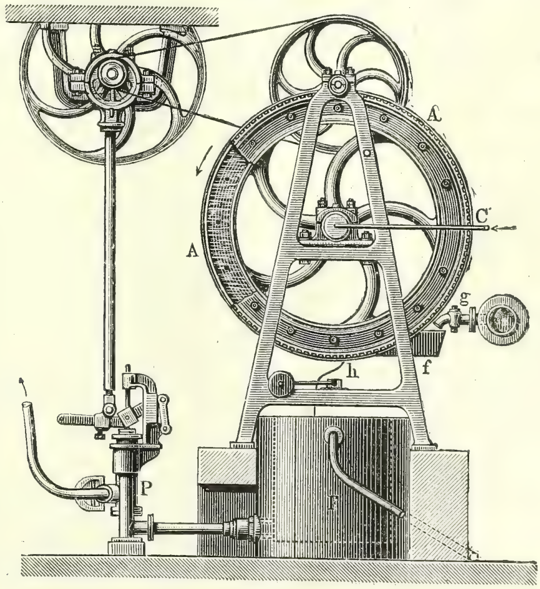


FIG. 20.



mass collected in the cooled vessel F, from which it is pumped through pump P into a filter press. The crystals are then introduced as an intermediate product at a suitable stage of the process into the crude candle material. The oleic acid may be converted as far as possible into solid candle material in the manner shown above.

If the raw candle material charged into the autoclave be of inferior quality and incapable of yielding white stearine by expression, then the total mass from the autoclave is acidified, *i.e.*, treated in the manner described already under the acid saponification process, and separated after distillation into stearine and oleic acid.

The hot pressed stearine is then ready to be moulded into candles. This is done in well-known machines, like that shown in the later part of the lecture (Fig. 23), with that difference that in the latter machine the bobbins on which the wicks are wound in a candle-moulding machine are left out.

The moulded candles, before being placed on the market, are polished, washed, dried, and finally branded, if required, in a set of machines which I show in a series of lantern slides.

Owing to the expensiveness of stearine, paraffin wax is being largely used in admixture with stearine. A series of cast blocks of candle materials representing mixtures of "stearine" and paraffin wax in various proportions are exhibited on the table here.

(To be continued.)

Miscellaneous.

*THE HOUSING QUESTION.**

There is a great and complex interaction between a house, its surroundings, and its occupants. If homes are to be made more wholesome, all these three factors must be improved. Our schools must give better moral training for life, and their influence must be extended by continuation classes. Houses must be put into, and maintained in, good order by a system of continuous inspection. In new districts houses must have pleasant surroundings, the air must be kept as free from smoke as possible, and the dwellings of persons of different social classes must be intermixed. While the building of tall tenement houses must be prevented, the "one-family house" should cease to be the predominant type of workman's house in and quite near to large towns. The growth of towns should be controlled by extension plans, and building districts should be created—some reserved for manufactories, and others for dwellings. In the districts more remote from the centre, houses should not be allowed to have as many storeys, and sites to have as large a proportion covered with buildings, as are allowed in districts nearer the centre of the town. Town councils should have the power to buy and hold land for general purposes, to rate land on its selling value, and to levy rates on increase of value when property is sold. The incorporation of surrounding districts by large towns should be made much easier. Tramlines ought to be made by town councils, but not till much land has been bought and a town extension plan prepared. Town councils ought to be strengthened by the employment of paid mayors and chairmen of committees, who ought to be appointed for long periods.

* Paper read by T. C. Horsfall before Section F of the British Association.

General Notes.

COMMERCIAL EDUCATION.—The City of London College, which opened for its 57th session on Saturday, is inaugurating a scheme of commercial education. A day clerical commercial school is to be opened, and later on a higher commercial school will be established. In the evening classes the work will be systematised, and courses will be commenced, extending over two or three years, in banking, the various branches of insurance, for accountants, for those engaged in secretarial work, for surveyors, and for those engaged in merchants' offices. An extensive school of modern languages will be opened, and not only will the French, German, Spanish, Portuguese, and Dutch languages be thoroughly taught, but in French and German, persons who are actually engaged in commerce will give instruction in the business methods and commercial and mercantile institutions and documents of France and Germany.

SCHOOL OF ART WOOD-CARVING.—The School of Art Wood-carving, South Kensington, which now occupies rooms on the top floor of the new building of the Royal School of Art Needlework in Exhibition-road, has been re-opened after the usual summer vacation, and some of the free studentships maintained by means of funds granted to the school by the London County Council are vacant. The day classes of the school are held from 10 to 1 and 2 to 5 on five days of the week, and from 10 to 1 on Saturdays. The evening class meets on three evenings a week and on Saturday afternoons. Forms of application for the free studentships and any further particulars relating to the school may be obtained from the manager.

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Proceedings of the Society.

CANTOR LECTURE.

OILS AND FATS—THEIR USES AND APPLICATIONS.

By Dr. J. Lewkowitsch, M.A., F.I.C.

Lecture IV.—Delivered February 15th, 1904.

(Continued from p. 842.)

Soap Industry.

Whereas the chief care of the candlemaker is directed to obtain as much free fatty acid, and especially solid acids, as possible, the main object of the soapmaker is to obtain *all* the fatty acids in the form of soap, *i.e.*, in the form of sodium or potassium salts of fatty acids. Hence, he will, when hydrolysing his fats, use as an accelerator only such a base as will yield him straightway hard soaps—sodium salts, or soft soaps—potassium salts. In other words, the soapmaker hydrolyses (saponifies) his oils and fats with caustic soda or with caustic potash, in an open pan, and converts, by the well-known suitable treatment, the soda salts into a mass which on cooling in large frames —soap frames (a model of which I show here) —solidifies, in the course of a few days, to a solid block. The sides of the soap frames are then removed, and the rectangular block of soap left is first cut into slabs of the required thickness, either by hand, or by a machine such as shown in Fig. 21, and then into tablets by a machine such as shown in Fig. 22.

As the solidification of the soap requires several days, attempts have not been wanting to shorten the time required for cooling from the finishing operation in the soap pan to the conversion of the solidified soap into the marketable bar or cake.

I have attempted to effect this by sending the soap through a long worm, cooled artificially*, but the soap so obtained represented an unsaleable mass, owing to the crystalline structure of the soap having been destroyed. Another attempt to effect this rapid solidification of the hot soap mass was made by moulding the soap in the same manner as candles are moulded.† The machine used for this purpose (Fig. 23), is fashioned after the well-known candle moulding machine. It was chiefly intended for the manufacture of toilet soaps, in which the crystalline structure, so much valued in household soap, is destroyed. The hot soap mass was run into the several moulds shown in the figure, and after suitable cooling, the solidified soap was expelled in the same manner as moulded candles are forced out.

This machine proved unsuitable for household soaps, but the idea underlying the construction of this machine has been recently taken up and patented by Schnetzer. At present nothing can be said as to the success obtained by his plant. Another attempt to shorten the time required for solidification has been made by Klumpp, whose press is best described as being fashioned after a copying press, the sides of which are completely closed. The hot soap is run into the press, and when full, the soap is cooled rapidly and compressed, so that the soap bars are immediately ready for being divided into tablets. A combination of the principles embodied in these two patents may be said to be contained in Schrauth's patent.

We have learned from the fundamental equation representing the hydrolysis of fats (Lecture III., Equation 1, p. 823), that glycerin results as the second product. The candlemaker obtains the glycerin in an aqueous solution. The soapmaker, however, who produces hard soaps in an open pan, obtains his glycerin in a solution containing a large amount of salt, alkali, and impurities, but so small an amount of glycerin that up till about two decades ago the soapmaker's so-called "spent lyes" were run away into the nearest watercourse.

* Lewkowitsch, "Problems in the Fat Industry," *Journ. Soc. Chem. Ind.*, 1903, 597.

† English Patent, No. 4581, 1893.

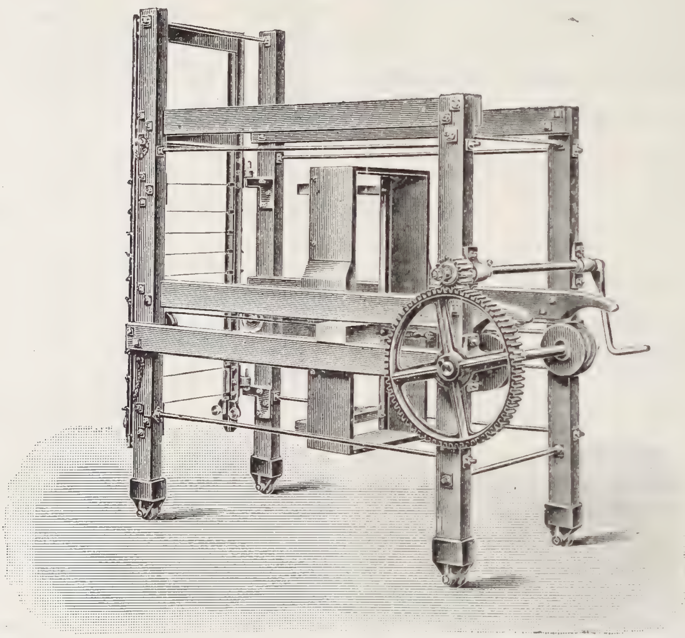
Although it was well known that immense quantities were wasted in this fashion, still, the great difficulties that beset the recovery of glycerin from the spent soap lyes militated against their being worked up on a commercial basis. But since the employment of nitroglycerin in the manufacture of dynamite, blasting gelatine, and a host of other modern high explosives, created an enormous demand for glycerin, the recovery of glycerin from soap lyes has been taken up energetically, with the result that practically every large soapmaker in this country recovers the glycerin from the spent lyes.

It may as well be pointed out that this country has taken a leading part in this industry, and was practically the first to recover glycerin from the soap lyes on a large scale. America and France have followed suit, and the most prominent soapmakers there now produce glycerin from their lyes.

In other countries, where the soapmaking industry has not yet reached the rank of the important chemical industry it really is, and where it is only slowly emerging from the stage of a house industry, the recovery of glycerin is still in its infancy. This is chiefly due to the fact that soapmaking is in the hands of many small makers, so that in a town of 10,000 inhabitants three or four soapmakers will be found to supply the local demand.

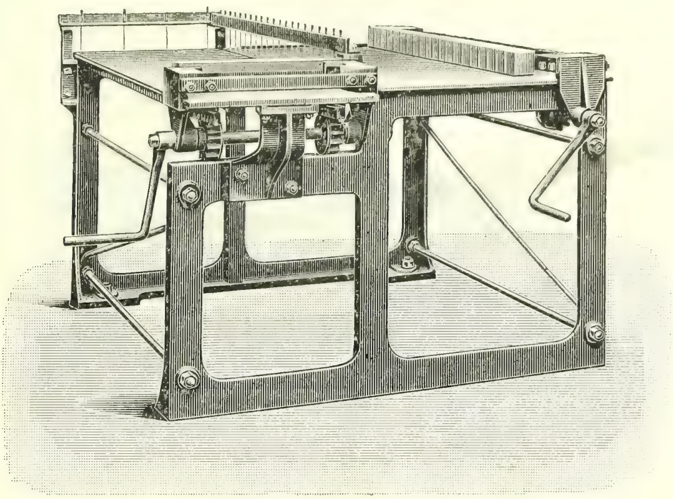
The present flourishing state of the soap industry in this country, chiefly due to the profits resulting from the recovery of the glycerin, has latterly drawn the attention of technologists on the Continent to the method of obtaining the glycerin from the fats first, and then converting the fatty acids into soap. Theoretically considered, this seems the most natural process, and for the last 70 years this process has indeed been practised in a number of candle works. The oleic acid was there converted into soap by boiling with caustic soda, or more simply still with sodium carbonate, a process which, theoretically, is identical with that of neutralising, say, hydrochloric acid by sodium carbonate.

FIG. 21.



The products which the candlemaker thus obtained being dark, the soaps so produced were dark and of evil odour. This method has again been taken up lately on the Continent, but in order to minimise the darkening effect which the fatty acids must suffer in an autoclave, the pressure was reduced, and thus a better looking product was obtained than from material autoclaved at the high temperature. This modification has, however, that important

FIG. 22.



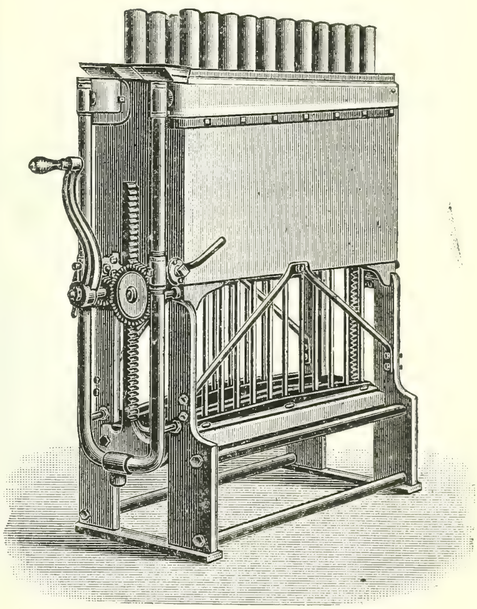
drawback that saponification cannot be carried on to the end, and products are obtained which contain 15 to 20 per cent. of unsaponified fat. The glycerin contained in this unsaponified portion of fat is irretrievably lost, as it does not pay to recover it from the lyes obtained in the soap pan.

These "improved" processes are being put on the market as new or "patented" processes with a great flourish of trumpets and an amount of advertising in the trade papers, which betrays too openly the interest that some makers of autoclaves have in pushing their wares. There are no less than about 40 processes on the market, each of which claims to work with an autoclave of its own, or, if you like, about 40 different autoclaves, each of which is worked with a "special process."

After what I have said before, I need not point out that these patents are valueless, and it is not a little amusing to see the travelling agents for these autoclaves on their visit to this country shake their heads mournfully over the backward state in which our chemical manufacturers in general, and our soapmakers in especial, are still found.

Of course, these methods have been tried long since in this country, and have been found wanting, as the soap so obtained is unquestionably darker and unsaleable, at any rate in this country, at its proper price. On the Continent these processes may commend themselves to some extent to those soapmakers, who have hitherto wasted their glycerin, and who are able to sell a soap at which an English housewife would look askance. But even on the Continent it is candidly being acknowledged that first-class soaps cannot be obtained by an autoclave process.

FIG. 23.



In the case of *soft* soap the glycerin has hitherto not been recovered, and it passes wholly into the soap. Although the soapmaker consequently loses the profit the glycerin might bring him, he has at least this advantage, that his soap is a readily saleable

article, commending itself by its brilliancy and transparency.

Soft soaps made from autoclaved material, and therefore very poor in glycerin, are of

FIG. 24.

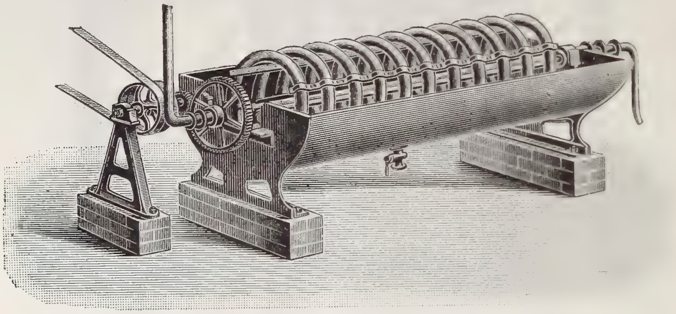
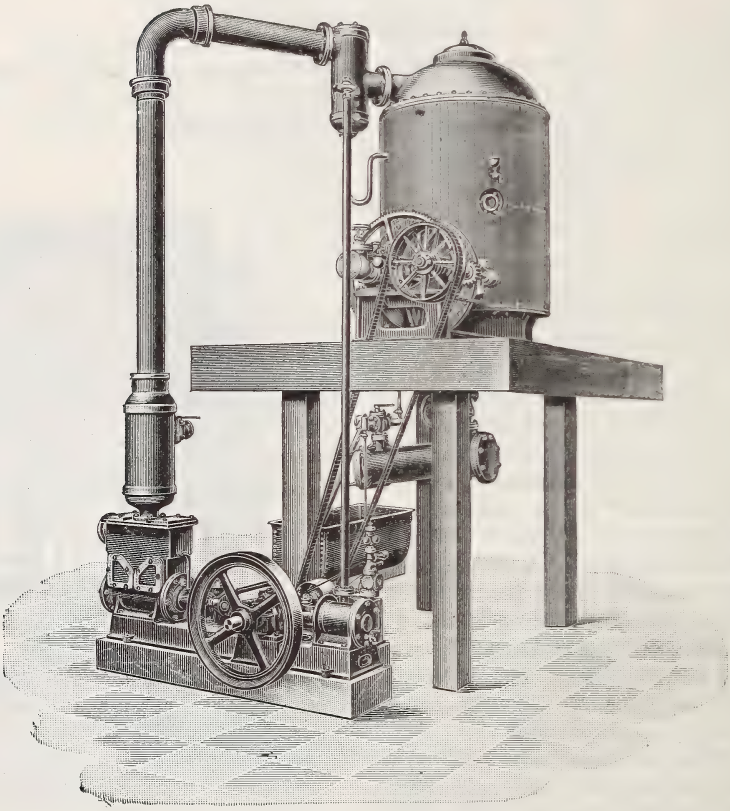


FIG. 25.



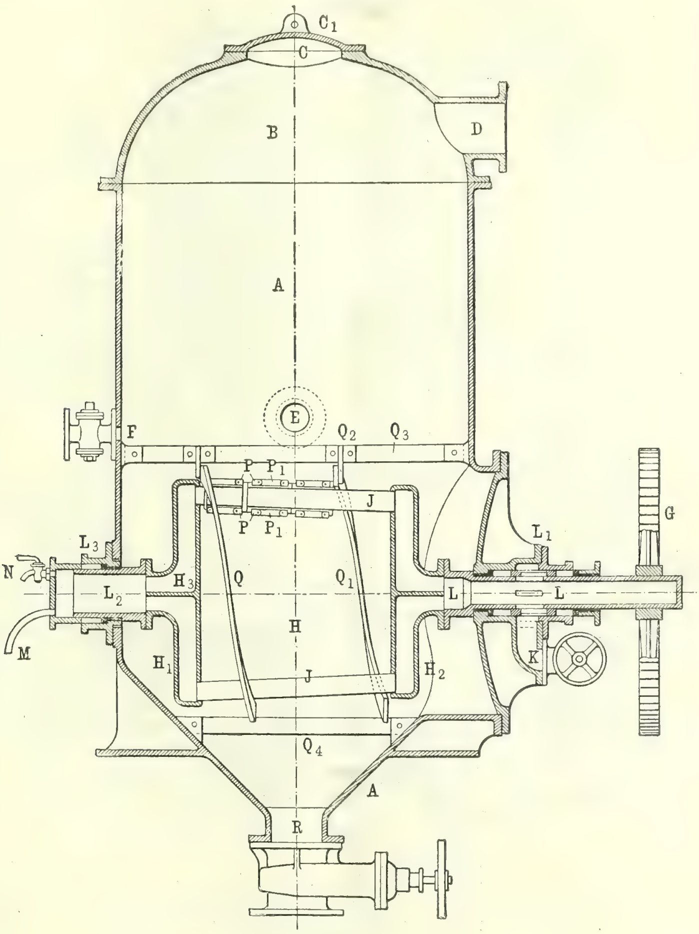
dark colour and of uninviting appearance. Besides, they will not, in the true sense of the word, hold water, which the soapmaker is always suspected (erroneously, I may add) by the public to make it his chief business to introduce into soap. Moreover, woollen manufacturers, the greatest consumers of soft soap, will not accept a soft soap devoid of glycerin for their best materials, as the glycerin in the soap gives that soft feel and gloss which are, *e.g.*, in cashmeres, the first recommendation to the buyer.

I am aware that in one or two establishments in this country the making of soft soaps from fatty acids is being carried out experimentally—for a good traveller will always be

able to find one or two customers. The future must show how far the dark soaps produced there will be able to maintain themselves in the market.

Toilet soaps are prepared from "genuine" soaps made by the boiling process. As a preparatory process the bulk of the water must be removed. This is done by cutting the soap into fine shavings by means of a rotary cutting machine, and spreading the shavings on trays in a steam-heated chamber. In large establishments the shavings are carried on an endless band through the drying apparatus. The soaps lose thereby about 20 per cent. of water, and are then ready to be worked in a milling machine, between granite rollers, into fine shreds. At this stage of the operation colouring matter, as also perfumes and medicaments, are intermixed. The mass is repeatedly passed between the rollers until a uniform mass is obtained. The shredded soap is next transferred to a machine in which the shreds are compressed by means of a screw, and driven against a plate perforated with a number of small holes, so that the soap passes this part of the machine in the form of single thick threads. These are again compressed at a somewhat elevated temperature, so that the threads can coalesce and leave the machine in the shape of a continuous bar of soap. This bar is then cut up into small cakes, which are finally stamped, and then present the familiar form of the soap tablet.

FIG. 26.

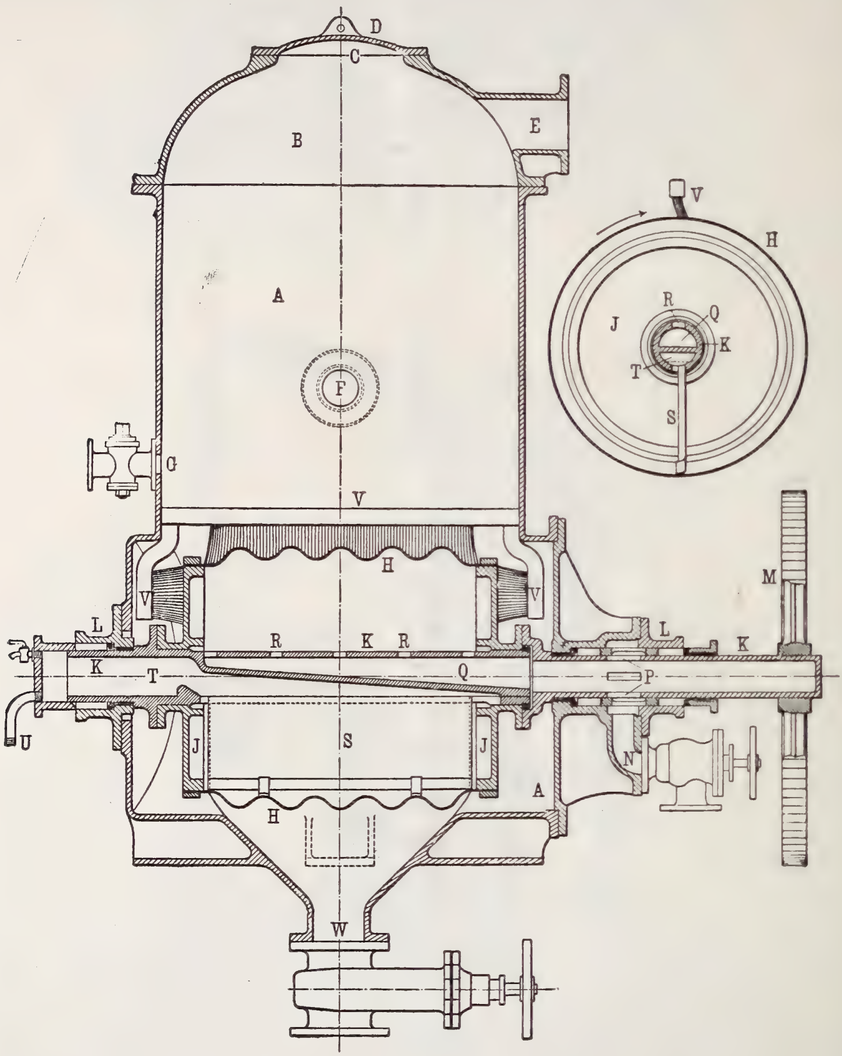


Another kind of soaps that are coming very much to the front are *dry soaps*. They are prepared by grinding together hard soaps with sodium carbonate. The hard mass obtained thereby is broken up in a mill, and then reduced to fine powder in a disintegrator.

I have repeatedly mentioned the second product obtained in the saponification of oils and fats, viz., glycerin. We have seen that both the soapmaker and the candlemaker recover this valuable by-product. In the case of the candlemaker, the process of recovery is very simple, as the sweet water from the autoclaves is practically nothing else than a dilute solution of glycerin, which, after some purification, only requires to be concentrated down to a specific gravity of 1·24 (the concentration required by the market). Formerly the apparatus used for the concentration was the Wetzel pan (Fig. 24), but in modern establishments this has been replaced by a vacuum tube evaporator, such as is used in sugar works. The outer appearance of a tube evaporater is represented by vessel B in Fig. 28, p. 849.

In the case of the glycerin solutions resulting from the acid-saponification process, large quantities of calcium sulphate remain dissolved. This calcium sulphate separates out on concentrating the solution. Hence a hard crust would be rapidly formed on the tubes, thus very seriously reducing the evaporative power of the apparatus, unless the calcium sulphate were removed continually. In this case, tube evaporators are therefore completely useless, and must be replaced by such apparatus as I shall show have been employed with advantage in the recovery of glycerin from soap lyes.

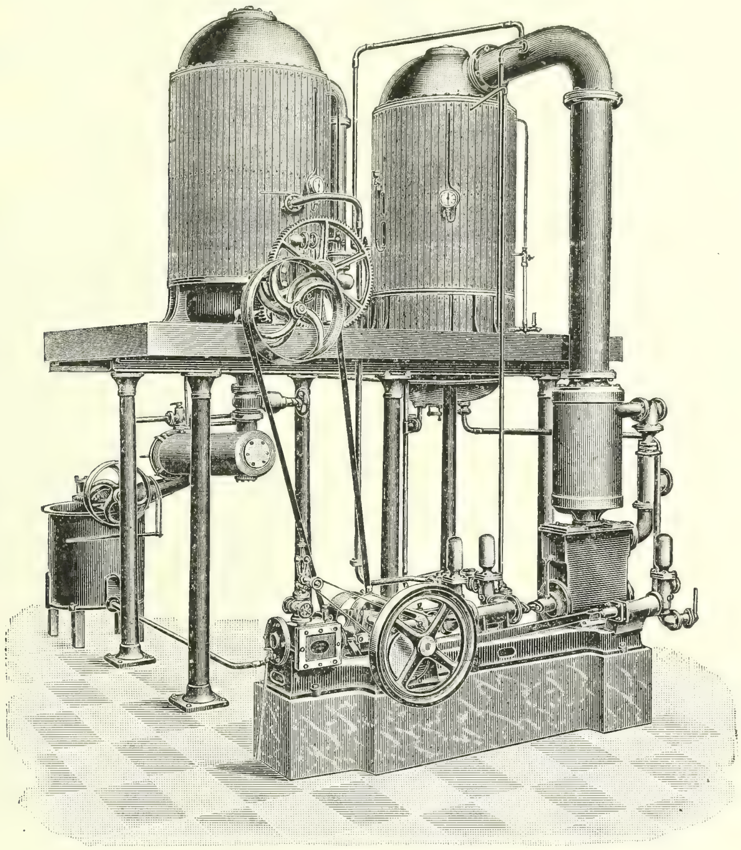
FIG. 27.



In the case of these lyes the problem is more complicated, inasmuch as we have to deal (after their complete purification) with a solution containing a few per cent. of glycerin only, and a considerable proportion of salt, up to 13 per cent. Now, if the evaporation of these lyes has been carried so far that the proportion of salts reaches about 20 per cent. or more, salt begins to fall out. Since the glycerin has been only enriched so far that its proportion is about 10 to 12 per cent., whilst the finished crude soap glycerin as required by the refiner must contain 80 per cent., it is evident that an enormous amount of salt must fall out, before so high a concentration of the glycerin can be reached. The salt which separates out must of course incrust the vessel in which the concentration is carried out.

When the recovery of glycerin from soap lyes was first introduced, this incrustation caused such enormous trouble that for a long time the new industry was in danger of succumbing to these difficulties. A certain progress was reached through carrying out the concentration in fire-heated pans, the sides of which were kept free from deposit of salt by suitable stirring and scraping arrangements. Later on, evaporation by steam in tube evaporators such as are used in sugar works was introduced; but as these tube evaporators are liable to incrustation with salt and the heating tubes to complete stopping up, I have constructed a (patented) vacuum evaporator, which has been found suitable in practice for the concentration of soap lyes. An evaporator of this type—consisting of one vessel, "Single Effet"—is shown in Fig. 25. Two types of the rotating heating surface are shown in Figs. 26 and 27. From the illustrations it will be gathered that the heating surface is kept clean by means of a mechanical arrangement, so that the salt as it falls down can be drawn off with the help of the vessel attached to the bottom of the pan (Fig. 25), without it being necessary to

FIG. 28.



interrupt the boiling in the vacuum pan. In large establishments, multiple evaporation commends itself on account of the greater economy. Taking advantage of the fact that up to that point when the salt begins to separate a considerable amount of water may be evaporated without fear of incrustation, I have combined in my (patented) "Double Effet" (Fig. 28), a tube evaporator with the "Single Effet" shown in Fig. 25. The soap lyes are therefore concentrated first in vessel B until they reach "salting point," that is until they reach that point at which the salt commences to separate. They are then transferred into the vessel A, in which the salt is removed as it falls out, whilst the boiling is kept up uninterruptedly. When the specific gravity of the sample has reached 1·3, the finished glycerin is withdrawn. The "Triple Effet" which I show in the next lantern slide is constructed on similar lines.

I exhibit here a number of crude glycerins which have been obtained by the several saponification processes described above.

All these glycerins must be purified by distillation in apparatus similar to that shown in the next slide, in order to be converted into the straw-coloured "dynamite" glycerin of specific gravity 1·261 (various makes of which I show here in these bottles), and by a second distillation into the well-known water-white chemically pure glycerin.

I have endeavoured, in the limited space allotted to me, to lay before you a rapid survey of those industries which, in their aggregate, form the technical side of the fat and oil trade of this country. From the tables of imports and exports given in the first lecture, you have been able to gather the vast extent these industries have reached. Yet not only the amount of capital invested is enormous, but also a very large amount of scientific work has been done in this country in order to place these industries on a thoroughly scientific basis. Here is a branch of chemical industry which proves that this country is in the forefront, and is able to teach our friends on the Continent, and in America, a good deal yet. We are almost daily being confronted by a number of writers with the lament over the backward state of our chemical industries, and the enormous dividends paid by tar-colour manufacturers abroad are being continually held up to us. They all seem, however, to forget the large dividends which our soap and candle manufacturers are paying. Whilst in Germany, as far as I am aware, hardly more than ten or fifteen chemists find employment in the whole soap industry proper, I know of at least two works in this country in which more than that number are engaged. If the high position which the oil and fat industries have earned by hard work, both in the factory and in the laboratory, is kept up by our young men proceeding to work in a truly scientific spirit, then we may rest assured that we shall continue to maintain the supremacy we have held so long in these industries.

Miscellaneous.

*EVOLUTION OF THE MUSICAL BOW.**

It is commonly accepted as a fact, which is borne out by tradition, both ancient and modern, that certain groups of stringed instruments of music must be referred for their origin to the bow of the archer. The actual historical record does not help us to come to a definite conclusion on this point, nor does the direct testimony of archæology, but from other sources very suggestive evidence is forthcoming. A comparative study of the musical instruments of modern savage and barbaric peoples makes it very clear to one that the greater portion of the probable chain of sequences which led from the simple bows to highly specialised instruments of the harp family may be reconstructed from types still existing in use among living peoples, most of the well-defined early stages being represented in Africa at the present day.† The native of Damaraland, who possesses no stringed instrument proper, is in the habit of temporarily converting his ordinary shooting bow into a musical instrument. For this purpose he ties a small thong loopwise round the bow and bow-string, so as to divide the latter into two vibrating parts of unequal length. When lightly struck with a small stick the tense string emits a couple of notes, which satisfy this primitive musician's humble cravings for purely rhythmic sound. Amongst many other African tribes we find a slight advance, in the form of special rather slightly made bows constructed and used for musical purposes only. In order to increase the volume of sound, it is frequently the custom amongst some ot the tribes to rest the bow against some resonant body, such as an inverted pot or hollow gourd. In many parts, again,

* Extracted from the address to the Anthropological Section of the British Association, at Cambridge, by Henry Balfour, M.A., President of the Section.

† "The Natural History of the Musical Bow," by H. Balfour. Clarendon Press, Oxford.

we find that the instrument has been further improved by attaching a gourd to the bow, and thus providing it with a permanent resonating body. To achieve greater musical results, it would appear that somewhere in Africa (in the West, I suspect) two or more small bows were attached to a single gourd. I have, so far been unable to trace this particular link in Africa itself, but, curiously enough, this very form has been obtained from Guiana. It may be thought that I am applying a breaking strain to the chain of evidence when I endeavour to work an instrument from South America into an African developmental series. But, when we recall the fact that evidence of the existence of indigenous stringed instruments of music in the New World has yet to be produced, coupled with the certain knowledge that a considerable number of varieties of musical instruments, stringed and otherwise, accompanied the enforced migration of African natives during the days of the slave trade, and were thus established in use and perpetuated in many parts of the New World, including the north-east regions of South America, we may, I think, admit with some confidence that in this particular instance from Guiana to Guinea is no very far cry, and that the more than probable African origin of this instrument from South America gives it a perfect claim to take its place in the African sequence. I still anticipate that this type of instrument will be forthcoming from some hinterland region in West Africa. Were no evidence at all forthcoming of such a form, either in past or present, we should be almost compelled to infer that such a one had existed, as this stage in the sequence appears to be necessary to prevent a break in the continuity of forms leading to what is apparently the next important stage, represented by a type of instrument common in West Africa, having five little bows, each carrying its string, and all of which are fixed by their lower ends into a box-like wooden resonator. This method of attaching the bows to the now improved body of the instrument necessitates the lower attachment of the strings being transferred from the bows to the body, so that the bow-like form begins to disappear. The next improvement, of which there is evidence from existing types consists in the substitution of a single, stouter, curved rod for the five little "bows," all the five strings being serially attached to the upper end of the rod, their lower ends to the body as before. This instrument is something rare now, and it may well be a source of wonder to us that it has survived at all (unless it be to assist the ethnologist), since it is an almost aggressively inefficient form, owing to the row of strings being brought into two different planes at right angles to one another. The structure of this rude instrument gives it a quaintly composite appearance, suggesting that it is a banjo at one end and a harp at the other. This is due to the strings remaining, as in the preceding form, attached to the resonating body in a line disposed transversely, while the substitution of a single rod for the five "bows" has necessitated the disposal of their upper attachments in a longitudinal series as regards the longer axis of the instrument. Inefficient though it be, this instrument occupies an important position in the apparent chain of evolution, leading on as it does through some intermediate types to a form in which the difficulty as regards the strings is overcome by attaching their lower ends in a longitudinal series, and so bringing them into the same plane throughout their length, In this shape the instrument has assumed a harp-like form—a rude and not very effective one, it is true, but it is none the less definitely a member of the harp family. The modern varieties of this type extend across Africa from west to east, and the harps of ancient Egypt, Assyria, Greece, and India were assuredly elaborations of this primitive form. The Indian form, closely resembling that of ancient Egypt, still survives in Burma, whilst elsewhere we find a few apparently allied forms. In all these forms of the harp, from the rudest Central and West African types to the highest ornate, and many-stringed examples of Egypt and the East, one point is especially noteworthy. This is the invariable absence of the fore-pillar, which in the modern harps of Western Europe is so important, nay, essential, a structural feature. In spite of the skill and care exercised in the construction of some of the more elaborate forms, none were fitted with a fore-pillar, the result being that the frame across which the strings were stretched was always weak and disposed to yield more or less to the strain caused by the tension of the strings. This implied that, even when the strings were not unduly strained, the tightening up of one of them to raise its pitch necessarily caused a greater or less slackening of all the other strings, since the free end of the rod or "neck" would tend to be drawn slightly towards the body of the instrument under the increased tension. One can picture the soul-destroying agonies endured by two performers upon these harps when endeavouring, if they ever did so, to bring their refractory instruments into unison, while, as for the orchestral music of the old Assyrian days — well, perhaps we had better not attempt to picture that ! The mere addition of a simple, strut-like support between the free end of the "neck" and the "body" would have obviated this difficulty and rendered the instrument relatively efficient and unyielding to varying tension. And yet, even in Western Europe, this seemingly obvious and invaluable addition did not appear, as far as I can ascertain, until about the 7th or 8th century A.D. ; and even then it seems to have been added somewhat half-heartedly, and a very long time had yet to elapse before the fore-pillar became an integral part of the framework and was allotted its due proportion in the general design.

I have purposely selected this particular series for my illustration, not because it is something new—indeed, it is already more or less familiar, and may be has even some merit in its lack of newness, since, in accordance with a popular dictum, it may urge a greater claim to be regarded as true—nor because it

is specially striking, but rather for the reason that it illustrates suitably several of the points upon which I wish briefly to touch. Even in the severely condensed form in which I have been obliged to present this series of developments from bow to harp, there is, I think, demonstrated the practical application of several of the general principles upon which is based the theory whereby Colonel Lane Fox sought to elucidate the phenomena of human progress.

Correspondence.

DAMMING THE THAMES.

During the last two or three years various proposals have been put forward for construction of dams or solid weirs across the Thames. These plans generally include sluices, overflow outlets, or other adjuncts. Some of these have been advocated or sought to be justified under the notion of economising the waters of the river, and, mainly, with the object of enlarging its scope for pleasure purposes. These seemed to be the chief motives on behalf of the scheme for constructing a huge dam across from Putney to Chelsea, which not long ago caught on with mere popular opinion. No serious public examination of these schemes has yet been undertaken (so far as I am aware); but now the Society's *Journal*, of September 2nd (see *ante*, p. 783), puts before us—transferred from the proceedings of the British Association, held at Cambridge—a grand project, by far the most ambitious, not to say heroic, yet broached. This gives definite specifications for construction of a huge masonry dam, or "barrage," across the river from Gravesend to Tilbury. The objects of this stupendous scheme are the largest possible: and, in themselves, worthy to invite support from the highest sentiments of patriotism, alike metropolitan and national. These comprise—Control of the enormous volume of commerce flowing into and out of the Port of London; a perennial supply of fresh water, without going to Wales; clearing away the foul-smelling mud banks that now disfigure the river; and, above all, providing a harbour of refuge for our (retreating) fleet, and our arsenals, now at the mercy of an enemy, at Woolwich and Chatham, thus providing an absolute protection against invaders.

Well, this is magnificent; but my humble wish is to raise the previous question—Is it business? The only excuse for "putting in my oar" is that, during many years, my attention has, now and again, been drawn to the ever open subject of the navigation and most effective utilisation of the manifold facilities afforded by the *tidal* river system of the Thames. But, being a layman, in view of the various engineering questions that arise, it behoves me to keep, mainly, to interrogative suggestions. It may be a taking idea to "control" the floating commerce of our metropolitan seaport; but what must be the effects of "controlling" the great rise of tide on what its access depends? and what other physical results must follow from checking the natural scour of the river which keeps the estuary open? And what will be done to protect or regulate the lines of the banks, more so on the southern side? Mr. Casey will point to his sluices and overflow outlets; but what engineer will define the relation between the absolute artificial obstruction of such a big deep dam, and the present natural force of the outflowing tide and river itself? Then as to consequences that may arise below the dam to the estuary itself from this attempt to "control" the incalculable forces of the tides in and out? What gigantic dredging operations can compensate for the rapid silting that must occur to the natural mouth of the river itself? What would be the value of the large artificial "pool" if ocean liners and our retreating fleet (save the mark!) could not get into it, should "the proposed depth of 30 feet" be shallowed even for a day or two, to 25 or it might be 20 feet? As to the effect on the river bed above the dam when the natural scour should be abated, would there not soon be widening mud-banks which would baffle the wits of the Thames Conservancy to control? As regards this aspect of the matter there is one minor initial question which does not seem to have been yet answered, namely, what proportion or percentage of the natural flow of the river has been checked or restricted by the moderate interruption caused by the Richmond weir and the Tower-bridge piers?

However, this note of interrogation or warning may suffice to challenge the opinion of experienced harbour, and other civil engineers. To myself, as an outsider, this bold and ingeniously devised scheme seems at variance with the old maxim, "Nature is to conquered by obeying her laws," whereas this begins by defying her.

W. MARTIN WOOD.

Weybridge, Sept. 23.

General Notes.

HISTORIC HOUSES.—Messrs. Knight Bros. have produced a series of picture post-cards illustrative of twelve London houses which have been the residences of eminent persons. Eleven of these are houses which have been distinguished by Society of Arts tablets, and were associated with the names of Lord Byron, Sir Joshua Reynolds, Dr. Johnson, Michael Faraday, Robert Browning, Mrs. Browning, Keats, Sheridan, Sir Robert Walpole, David Garrick, and Hogarth. The twelfth is the reputed birthplace of Lord Beaconsfield, in Theobald's-road.

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Proceedings of the Society.

THE MAJOLICA AND GLAZED EARTHENWARE OF TUSCANY.

By Prof. R. Langton Douglas, M.A.

Lecture I.—Delivered April 25th, 1904.

I.—The Majolica of Siena.

Of all the arts that of the potter is one of the most ancient and most universal. It is, moreover, one of the most artistic and one of the most human. It is one of the most artistic; for it does not rely for its effect on the costliness of its materials. Earthenware at least, glazed or unglazed, is made from clay—from an inexpensive material—and all its beauty is due to the constructive imagination of the artist and his skill of hand. It is one of the most human of the arts, in that, like architecture, it springs directly out of social needs. It is not less true of styles of pottery than of styles of architecture that they grow out of their social environment just as a tree grows out of the soil, and are conditioned by their social environment just as a tree is conditioned by its physical environment. For this reason, the study of ceramics is scarcely less important to the sociologist and the historian than to the connoisseur and the student of æsthetics.

At first men fashioned vessels of coarse, unselected clay, and rude in form, which were hardened by drying in the sun. Then they took to ornamenting them with simple scratched lines, straight or curved. Subsequently it became customary to harden earthenware by baking. Later on the vessels were made less porous by covering them with a thin glaze without and within. And so throughout long ages the art developed, use being continually the suggester of beauty, until in Greece men were able to make vessels lovely in form and in decoration, and withal durable.

The branch of the potter's art of which I propose to tell a portion of the story in these lectures, is that known as majolica. The term majolica in its present significance connotes all glazed, or partially glazed, or enamelled wares. That it once had a narrower meaning is, I think, certain. It was first applied to the wares that came from Malaga, Valencia, and Majorca, or, as it was then called, Maiorica or Majolica. And, just as in England of the thirteenth century, all Italian bankers, whether Sienese or Florentines, Venetians or Milanese, were called Lombards, so all Hispano-Moresque pottery was given the name of one of its places of origin. A protectionist law passed in Venice in the year 1437 forbade the importation of all pottery ware except those "from Majolica." Thirty-seven years later in a decree of the republic the word majolica was applied to the wares themselves, and we read of "Majolica di Valenza." And in the year 1477 we find, in a similar measure promulgated by the government of Siena, the term "maiorica" obviously applied to the glazed and lustred wares of Valencia and Malaga.

Some think that the term majolica ought again to be confined to glazed and lustred wares. But such a reform is impossible. In England or Italy the term majolica is now universally applied to glazed and enamelled earthenware.

When, where, and in what way the process of glazing pottery was first discovered it is impossible to say. Speaking generally, three kinds of glaze are known to us—the vitreous, the plumbeous, or lead glaze, and the stanniferous, or tin glaze. Of these glazes the vitreous was the first to be invented. It certainly originated in the East, and probably in Egypt, Babylonia, or Phœnicia. In the art of the potter, as in architecture, necessity is the mother of invention. Men felt the need of making their vessels less porous. The discovery of glass suggested to some potter the means of attaining this end. Clay vessels were dipped in the liquid glass. It was found, however, that the vitreous substance would not adhere properly to the clay. Ultimately this difficulty was got over "by mixing with the clay siliceous sand, aluminous earth, and

probably," says Drury Fortnum, "a small portion of alkali." Thus, the body became of a more kindred substance to the glaze, and glaze and body firmly adhered to each other.

The vitreous glaze was translucent. When these early Eastern wares began to be decorated with colour, the pigment was applied to the piece before it was dipped into the glaze. It was in this way that the beautiful turquoise blue tiles and vessels of Egypt were coloured by the application of an oxide of copper.

The first or vitreous glaze was subsequently made more fusible by the addition of oxide of lead, and thus was obtained the lead or plumbeous glaze. This plumbeous glaze was certainly known in the East, having been found in Babylonian tiles that have been subjected to analysis; but it never came into general use in the Orient. In the south of Europe and in the western part of Asia Minor, a lead glaze was freely used, and it was probably brought into the west by Greek and Oriental potters. Its use, however, had not spread far in Italy before the general decay of art under the later Empire affected ceramics. And it was not until the twelfth century that a revival of the art began in northern Italy, probably under Byzantine influences. In the following century its progress was accelerated by an important change in the process of decoration. The natural colour of the clay—a buff, dull red, or brown colour—was not, it was felt, a suitable background for colour ornamentation. The practice was, therefore, adopted of covering the body of the piece with a white slip. A white, argillaceous earth was carefully ground and refined, and then mixed with water. The vessel was dipped into this and then dried in the sun. A pattern was then scratched through this white surface to the buff, or dull red, clay underneath. The vessel was then covered with the translucent lead glaze and fired. The ware that has a covering of white slip was styled mezza-majolica. When covered with incised ornament it has been styled *sgraffiato* ware.

Small bowls, or *bacini*, made of this ware, were used in the decoration of palaces and churches. Almost all known examples of these *bacini* are of Italian origin. But for my part I see no ground at all for calling in question the old tradition that the first *bacini* so used were trophies brought from the Balearic Isles by the Pisan seamen after their victories over the Moors. It is an undoubted fact that of this practice of adorning buildings with small bowls and plates Pisa was the chief centre. Pisa was a great maritime power, in constant communication both with Spain and with the Orient; and in her architecture are to be seen other traces of Oriental influence. It is, moreover, an undoubted fact that one of the *bacini* found in the church of St. Cecilia was of Oriental origin.

The third and latest form of glazing was the stanniferous. It was discovered that the plumbeous glaze, by the addition of a small quantity of oxide of tin, became white and opaque, and afforded a beautiful surface for the application of colour ornament. The vessel to be decorated was dipped in this stanniferous glaze, which was dried. Upon this absorbent surface the painter executed his decoration. The piece was then fired, and the firing both fixed the colour and liquified the glaze.

This white or stanniferous glaze was known in Persia in the time of Darius, and has been found on Babylonian bricks, but it was never generally adopted in the East. Probably it was merely used there as a white pigment. It was in the Moorish potteries in Spain, and in the Balearic Isles, in the thirteenth century, that the stanniferous glaze first came into general use. At the same time, the Hispano-Moresque potters generally adopted the practice of decorating their finer wares with metallic lustre. This lustre was produced by the reduction of certain metallic salts in the reverberatory furnace; which process left a thin film of metal on the surface of the piece. Lustre, like the stanniferous glaze itself, has been found on very early pieces in the East, as well as on specimens supposed to have been produced by Oriental potters in Sicily. But it was in Valencia, Malaga, and Majorca, in the early part of the fourteenth century, that this process of metallic decoration first reached perfection in Europe.

In the fourteenth century, there grew up an important trade in majolica between Italy and Spain. Plates and vessels from Majorca and Valencia were admitted free of duty, and were much prized. The free trade in this ware spurred on the Italian potters to improve the quality of their own products, and to seek to learn the processes in use in the *fabbriche* of Valencia and the west. Quite early in this age they adopted the stanniferous glaze; towards the close of the next century the lustre process began to be practised at Diruta and Pesaro.

Throughout the fifteenth century some *fab-*

briche had continued to make large decorative pieces of mezza-majolica, and the earliest plates decorated with metallic lustre are of this ware. But the knowledge of the lustre process acquired by the potters of these cities east of the Apennines, was only partial. The potters of Spain guarded jealously the mysteries of their art. And it was not until Galgano di Belforte, a potter of Siena, had, by strategy won his secret from a master potter at Valencia, that the process was fully understood in Italy. Then Maestro di Giorgio of Gubbio raised the art to the greatest height it attained in the peninsula. And in the same period such masters as Niccolò da Urbino, the Mazzaburroni and Bernardino di Matteo of Siena, and Maestro Benedetto produced unlustred wares of consummate beauty.

Having given this brief account of the rise of the art in Italy, I will relate the story of one of the most ancient and important of Italian potteries, that of Siena. There was a time when it was denied that Siena had a place amongst the historic centres of the art. Urbino de Gheltof asserted that there had never been a factory of artistic wares at Siena. Professor Argnani, a most patriotic Faventine, declares that the Sienese pottery was a late-born off-shoot of Faenza. Drury Fortnum surmised that the *fabbrica* of Siena took its origin from Cafaggiolo, a private pottery of the later Medici.

Some years ago, in an article in the *Nineteenth Century*, I demonstrated that Siena was one of the oldest and the most important of the centres where artistic wares were produced. Since that article was published, I have collected a good deal of evidence which corroborates my conclusions. It can now be shown that the *fabbriche* of Siena in which the most beautiful pieces were made were large potteries employing many craftsmen, and that a great variety of artistic wares was manufactured in this city, amongst which were multitudinous copies of classical vases, as well as lustred pieces.

It was only natural that Siena should become an early centre of this art upon its revival in Italy. The country round the city produced excellent materials for the potter. From the clay obtained near Siena could be made a body of good hard quality, whilst in the neighbourhood was also found the white *terrà di Siena*, most prized of all the substances that were used by Italian potters as a slip to cover the surface of the mezza-majolica, before its decoration and the application of the transparent glaze. We are not surprised, therefore, when we find this manufacture the subject of regulation in the great Sienese statute of 1262. "No Sienese," the clause runs, "shall have or hold, within the city's walls, any furnace in which pottery is baked." This stringent prohibition was, however, soon relaxed; for fifty years later we find many potters the owners of furnaces within the walls, and ultimately there was a large colony of these artists near the San Marco Gate, in the south-west corner of the city.

That some of these potters produced artistic wares can no longer be doubted. In certain Sienese inventories of 1291 and 1293, published by Professor Zdekauer in his *Vita privata dei Senesi*, we find mention of painted wares. In a document, too, of the year 1298, in the Archives of Siena, there are allusions to glazed and painted earthenware. Fragments of mezza-majolica have frequently come to light in the city, and the *contado*, and several of these are now in my possession. I have recently found at Orgiale, near the site of the great castle of the Imperial Counts, a small decorated *tazza* of the Dugento, which is at least of equal artistic merit to the pieces of this date that have been unearthed at Faenza and other Italian cities. Moreover, at the Spedale di S. Maria della Scala are three jugs of the *trecento*, made by the *vasaio* to the hospital, which prove that at that early date, as in a later age, the wealthy hospital employed ceramic artists of the first order. And in pictures of Duccio and Ambrogio Lorenzetti, painted in the first quarter of the fourteenth century, there are representations of beautiful jugs, vases, and pots, bearing in some cases Oriental designs.

A distinguished connoisseur, Mr. Henry Wallis, whilst admitting that some of these pieces may be of Sienese origin, will not allow that any of the finer vessels in these pictures were of Oriental design, or of local manufacture. I believe that further research will prove this conclusion to be mistaken. A great art movement always begins with imitation. For even in art, the most dynamic thing in the world, there is no such thing as spontaneous generation. There has never been an artistic Melchisedech. Chaucer began as a translator and an imitator. The young Raphael was the ape of Perugino. An artist likes to think that artistically he is a kind of aristocratic Topsy. It is not so. His art was born in a respectable, commonplace way. It has its hereditary

taints, and it is conditioned by its environment. And so, like other human institutions, art is very much affected by economic condition. In art, as in other things, the demand tends to create the supply. The Elizabethan public, for example, having learnt to think imperially, thirsted for stories and dramas full of blood and rant. Lurid Italian *novelle* and Senecan tragedies were at first imported to meet the demand. The local artists then began to make successful imitations of the foreign goods. Finally, as Marlowe had overgone the Italians, that arch-plagiarist Shakespeare out-Marlowe's Marlowe.

In the same way a public demand helped to stimulate the manufacture of artistic wares in Italy. In the fourteenth and fifteenth centuries high prices were paid for Hispano-Moresque wares. Enterprising local potters thought that by producing artistic pieces they might capture a portion of the trade. They began by seeking to imitate the fashionable Moorish designs. And it is probable that, like Chaucer, they served a long apprenticeship as imitators before they began to create new types more in harmony with the spirit of Italian art.* There are some grounds for believing that a considerable number of pieces that are now thought to be Oriental wares were made in early Italian *fabbriche* like Siena.

It may seem to you that, after the fashion of all sound scientific enquirers, I have formulated a theory on insufficient evidence, and am now searching for facts to support it. Well! perhaps you are not entirely wrong. The theory at present is not capable of absolute proof. But there is enough established to create a strong presumption in its favour. As at Diruta, pieces adorned with Hispano-Moresque patterns have been found, so at Siena fragments bearing similar designs, though unlustred, have also come to light. Some of the patterns, too, on early Sienese pieces in my own possession, show strong traces of the influence of the majolica of Valencia. Moreover, Hispano-Moresque wares were freely imported into Siena, where the inhabitants were more in sympathy with Oriental art than any other Italian people except perhaps the Venetians. The oak leaf jars† that were made in Siena in the early part of the fifteenth century bear patterns that are partially imitative, being free adaptations of Moorish designs. Is it unreasonable to conclude that some of the artistic products of Siena that preceded these were wholly imitative, and that some of the pieces of Oriental designs which are represented in Sienese pictures of the fourteenth century were made by local artists?

The representations of pottery in the pictures of the fourteenth century and the early part of the fifteenth century, as well as the pieces and fragments of pieces of early majolica that have come to light, prove that the Tuscan potteries continued to make, concurrently with these imitations of Hispano-Moresque wares, vessels that were purely Italian in form and in decoration. Many vessels of this character are represented in the picture of the school of Ambrogio Lorenzetti, to which I have already referred, which was painted about the year 1340. A fine mezza-majolica plate, of a somewhat earlier date than this painting, has recently been discovered in Siena, and has, I am glad to say, passed into the hands of the civic authorities. The body is covered with a white slip on which is a simple colour decoration. In the centre of the plate is a wolf, the badge of the Sienese republic. In my own collection are fragments of plates found on the site of a castle of the Malavolti of precisely the same *fabbrica*.

The names of many potters are found in documents of the early half of the quattrocento, and it was probably about the middle of that century that the so-called oak-leaf jars were first fashioned in Siena. I do not contend that all jars bearing this oak-leaf design were made there. In the fifteenth, as in the following century, potters were a migratory folk; and a method of decoration introduced into one pottery was doubtless soon copied in another. There are, however, distinct reasons for concluding that some of these jars were made in the city. In the first place we find upon some of them the badge of the great Sienese Hospital of Santa Maria della Scala, and one of these jars still remains in the possession of the hospital. It has been urged that these vases may after all be Florentine, because there was a small hospital having a similar badge at Florence. But the probability lies the other way. If documents prove anything they show that at this time Siena was a more important centre of ceramic manufacture than Florence. The Sienese Hospital was a very large and thriving institution, and we know from its account

* Since delivering these lectures, I have obtained proof of the truth of this theory. In the course of some months' search I have brought together a large number of fragments bearing imitations of Valencian designs, which have been found by labourers and stonemasons in different parts of the city.

† Perhaps "fern leaf jars" would be a more accurate designation of these pieces.

books that the governing body was wont to employ the most artistic potters to make the drug pots and other vessels. Owing in a measure to the influence of S. Bernardino, the Ospedale was especially prosperous at this period, and received large donations from the citizens. Until the year 1517 not one of the *vasai* whose name is found in the documents of the hospital is a foreign artist. Moreover, it is not likely that a public institution would have infringed the regulations against the introduction of foreign-manufactured pottery.*

Again, this oak-leaf design is of the same class as certain designs to be found on some of the wares of Valencia. Now Siena is the only centre of the art of which we know, from documentary evidence, that any of its majolica artists had direct relation with Valencia. And though the document that proves this belongs to a later date than the period when the oak-leaf jars were made, yet we know that from an early period Sienese artists had shown a strong affinity for the design and technical methods of Oriental art. They loved, too, to have Sienese things in their houses. It is in Sienese pictures that we find the earliest representations in the art of the Renaissance, of the metal jugs and ewers of Mosul, of Syrian silks, and of such beautiful Eastern carpets as that which is below the Virgin's throne in Ambrogi's beautiful little Madonna in the Siena gallery.

It is possible that it was Sienese artists who began the manufacture of these oak-leaf jars in other towns. For stress of competition within the city now began to drive Sienese artists to seek their fortunes abroad. We learn, for example, that in the year 1462 a Sienese artist, Ventura di Maestro Simone de Piccolomini, set up a pottery at Pesaro on the other side of the Apennines. The Bettini, too, the artists who, in the year 1480, made the earliest known pavements of tiles of Faenza in S. Petronio at Bologna, were probably members of a family of potters of the Sienese *contado*, a family that had a *fabbrica* in that early seat of ceramic manufacture, Asciano.

Notwithstanding the migration of some of their fellow artists, the potters of Siena still felt the pressure of competition. They began, therefore, to seek to persuade the Government of the Republic to consent to protective measures. In a petition of the year 1476, they pointed out that there were sixteen potteries in the city, that they were well managed, and produced more wares of good quality than sufficed to satisfy the requirements of the citizens. They asked that a heavy tax should be put upon foreign wares. This request was acceded to, and only the majolica of Malaga and Valencia was exempted from the duty.

It was about this time that the Sienese began to bring to perfection the manufacture of these *ambrogette*, or painted tiles, for which the city was famous. In the year 1488, Niccolò and Lorenzo Mazzaburroni made the beautiful tiles of the Bichi chapel in S. Agostino. A considerable portion of this pavement is still to be seen in the chapel. They are ornamented with leaves and trophies, and are well designed and well made. They prove that the Siena *fabbriche* were in no way inferior to those of any other city.

In this age, and in the early years of the fifteenth century, many Sienese buildings were similarly adorned with painted tiles. Already, in 1480, the Oratory of St. Catherine, in Fontebranda, had been paved with *ambrogette*. Twenty years later, in 1502 and 1504, this pavement was renewed, no doubt with tiles of finer quality. In the year 1509, the new palace of the tyrant of Siena, Pandolfo Petrucci, was similarly adorned; and at a later date the Piccolomini Chapel in S. Francesco was decorated with painted tiles from the local potteries.

As Sienese potters had gone forth from Siena to bear Sienese designs and Sienese technical processes to other cities, so wandering artists from other centres of the art found their way to Siena. Already in the year 1455 we find the names of a certain Evangelista de Michele, "pictor vasorum," and his brother Tommaso, in the Sienese archives. As I have already shown, these artists probably came from the pottery of Maestro Niccolò of Faenza. The most famous of these Faventine immigrants was that Maestro Benedetto, whose blue plate, *a porcellan*, is one of the glories of the South Kensington collection. He was the son of a certain Maestro Giorgio of Faenza, and seems to have come to Siena as a young man about the year 1503. He settled in the potters' quarter near the San Marco gate, and seven years later joined the great Sienese sick and burial society, the Compagnia di Santa Lucia. In the year 1522 he became consul of this confraternity.

* Since these lectures were delivered I have searched the archives of the hospital in the Archivio di State at Siena. I have now in my possession a great mass of documentary evidence which confirms the statement in the above paragraph. These documents will be published in my book on the majolica of Siena which has long been in preparation.

When I first instanced the works of Maestro Benedetto as proofs of the high character of the wares produced at the Sienese potteries, some objector said that I only knew of one piece made by him, and that his pottery was possibly a very small establishment, producing but a few fine pieces. At first I could only bring forward stylistic arguments in reply to such a contention. I could only point out several other works in which could be seen a strong similarity to the one signed piece of Benedetto. I am now able to show, from documentary evidence, that Maestro Benedetto's pottery produced large quantities of wares. The account books of the Hospital of Santa Maria della Scala show that in one year, in 1518, he made nearly two thousand pieces for this institution alone. Amongst them we find many large and important plates, as well as the little drug pots with a yellow ground so well known to collectors.* Two years later we find almost as large a list of goods provided. I know of no other pottery of this date in any city in Italy producing pieces of equal excellence which can be proved to have had so large an output.

Potters came to Siena from Urbino, as well as from Faenza. Giulio d'Urbino, an artist praised by Vasari, sojourned in Siena. Fedele, another compatriot, settled in the city, and patented there a new process for making vases adorned with a kind of *pâte-sur-pâte* decoration on a black ground.

But numerous as were the immigrant potters in Siena, as in every other centre of the art—for the potters were a migratory race—the local potters far outnumbered them. In the year 1529, when they compiled new statutes of their art, there were, in the city, sixteen chief master potters, as well as several lesser masters. The industry became of such importance that the local guild was given permission to organise two annual fairs, one on the feast of St. Mark, the other on the feast of SS. Philip and James. Moreover, the native-born masters produced large quantities of artistic wares, and showed even more spirit in their efforts to improve the quality of their productions than did the immigrant artists, thus proving themselves worthy successors of the early potters of Siena. In an inventory of a certain Sienese potter, Giovanni Battista di Luca, we find mention of large quantities of artistic pieces. It tells of "large plates," *dipenti a fregi*, of *scodella*, of drug-pots, and of decorated *tazzoni*. It was, perhaps, this Giovanni who painted those beautiful series of plates with the signature, "I. P.," of which examples are to be seen in the National Collection, and in Mr. Salting's collection at South Kensington, and also at the British Museum. The plate belonging to the Victoria and Albert Museum bears a representation of St. James the Great, that in Mr. Salting's collection a representation of St. Mary Magdalene, whilst on another plate of the series in the British Museum is the figure of St. Bartholomew. Not only is the pattern of grotesques on an orange ground which decorates these plates characteristic of Siena, and similar to the decorations of some of the Sienese *ambrogette*; in details of drawing, and in their technical qualities, these pieces also reveal their Sienese origin. The signature "I. P." may well stand for "Iohannes Pinxit."

The Sienese proved themselves to be very enterprising in seeking to fathom the ancient secrets of their art. They set themselves to discover the methods of the ceramic artists of classical antiquity as well as the mysteries of the Hispano-Moresque artists. I have already spoken of Galgano di Belforte.* Tizio, the Sienese chronicler, writing in the year of this heroic artist's return to his native land,† tells us how he ran great risks in order to acquire a complete knowledge of the lustre process. Going to Valencia, he disguised himself in vile apparel, and obtained some mean position in the establishment of a master potter; and, having learned the secret of this mode of decorating glazed earthenware, he returned in the year 1514 to his native city. Probably his first essays in his newly-acquired art were copies of pieces made in Valencia. There is in the British Museum a lustred piece, thoroughly Sienese in character, which bears the name Gano in a monogram. It is, perhaps, one of Galgano's later productions. It is not too much to assume that the improvements in the lustre process introduced into Italy by this artist helped to make possible the finest works of Maestro Giorgio. And no doubt many of the pieces attributed to Maestro Giorgio and to the *fabbrica* of Gubbio, as well as some pieces assigned to Valencia, are in reality works of Galgano di Belforte.

* These yellow drug pots of Maestro Benedetto must not be confounded with a series of *alborelli* of an earlier date, bearing a geometric design in yellow, blue, and orange, of which one example still belongs to the Hospital, and one was in the collection of the late Signor Pepi.

* Douglas, "History of Siena," p. 451.

† Tizio, "Historia," Tom. vii., p. 484, anno 1814

The Sienese also successfully imitated the black vases of classical antiquity. Documents that have recently come to light prove that these black vases were made in large quantities in Siena.* In the year 1527 the Sienese were seeking to induce Charles V. to leave them to enjoy their dearly-won liberty. Believing that his minister, the great Cardinal Granvella, was favourably disposed to the Republic, they sought to bribe him secretly to give active support to their cause. Through one of their ambassadors they offered him a thousand golden scudi. This bribe the great man refused, but on being pressed a second time he said that he liked very much the black vases "*a l'antica*" made in Siena, and that he would accept some of these if they were offered to him. Whereupon the ambassador, Mario Bandini, said that he would see that his masters, the Governors of the Republic, sent the Cardinal one thousand of the finest pieces that could be made. Maestro Alessandro di Bernardino di Niccolò, who lived in S. Marco, was commissioned to make the vases for the Imperial minister.

I have been shown sometimes in the houses of great families of Sienese origin quantities of black vases, said to be antiques. There are a great many pieces of this kind in the Chigi Palace in Rome. It is probable that many of these pieces are imitations made in Siena at the time of the Renaissance. The works of Galgano di Belforte and of this Maestro Alessandro demonstrate the artistic vitality of the ceramic artists of Siena, their eagerness to learn new processes, and to make works of the finest quality.

Siena, like other centres of the art, was visited by wandering artists from other cities, but the *fabbriche* there never lost their own peculiar characteristics. The Sienese majolica has a certain character of its own, a certain individuality which only now we are beginning fully to distinguish and to realise.

After the fall of Siena the local manufacture of pottery declined. The art, in fact, was already on the wane everywhere in Italy, and at Siena the fall of the Republic but hastened its decadence. For more than half a century, however, the Sienese continued to make the beautiful *ambrogette* for which their city was famous. In or about the year 1600, Maestro Girolamo di Marco entirely restored the pavement of the oratory of St. Catherine, renewing the greater part of it. In the seventeenth century the art of majolica did not entirely die out in the city; and in the following age it experienced a brief revival under Ferdinando di Giovan Battista Campani, who decorated plates and plaques with paintings after Raphael and the Caracci, and Marcantonio Raimondi. There are several pieces by this master in our public collections which well represent his achievement.

What, then, were the most important qualities of the majolica of Siena of the best period—the period of the Mazzaburroni and of Maestro Benedetto?

First of all, like the mezza-majolica of Siena, it is remarkable for the excellence of its materials. We find a hard, and, as a rule, somewhat light-coloured body, covered by a clear, fine glaze. Secondly, we note a preference for yellow backgrounds in the tiles and the drug-pots, and on the borders of the plates of their pottery. Thirdly, we see a predilection for grotesques, arabesques and trophies, as well as for free adaptations of Hispano-Moresque patterns painted in blue on a white ground. Fourthly, we find a certain niceness, neatness and love of finish in the authentic pieces of the *fabbrica*. There is little of the free, loose drawing, little of the barbaric splendour that characterises the designs on many Urbino plates of the same period.

It is true that each one of these qualities taken by itself may be found in the works of other *fabbriche*. It is the combination of two or three of them that marks a piece as belonging to the Siena pottery.

We are fortunate here in England in possessing the most beautiful of the known *maioliche di Siena*. I hope that what I have said this afternoon may lead some one who hears me to understand and enjoy them better. For me the human interest of these things is scarcely less than the æsthetic. Are they not full of suggestion? This plate a young lover gave as a present to his mistress. That tile was trodden by Pandolfo Petrucci as he hurried out, hot-foot, to seek Caterina of Salicotto. This bowl was brought to the bedside of a woman when she first looked upon the face of her first child. That *alborello* was handled by a learned leech in the old hospital of S. Maria della Scala just four hundred years ago. The greatest Emperor of the modern world ate fruit, perchance, from that *piatto di pompa*, whilst there stared down on him that huge jar, the property of the Republic, which bore ominously on the shield which deco-

* See "Notizie per la storia della ceramica in Siena," in the "Miscellanea Senese di Erudizione Storica," Anno vi, N° 5-6.

rated it, the one word, *Libertas*. It may be that he remembered that shield of Siena when he heard that his proud Spanish soldiery had been driven from the town, by the brave, lawless citizens. From that plate some starving lady of a noble house ate her last meal, when corpses were hanging, as thick as autumn fruit, in the trees of the Emperor's orchard outside the city's walls, what time the Republic was in her death-throes.

Yes! the art of the potter is the most human of the arts. And the study of it does not only increase our æsthetic enjoyment, and add to our knowledge of social history; for these pots and plates bring the men and women of old Siena very near to us, and make us long to tread again the streets of the redgirdled city among the Tuscan hills.*

Miscellaneous.

CONSERVANCY OF THE HUANGPU OR SHANGHAI RIVER.

This important question is now attracting much attention, and its present condition is seen from the note of the *Times* correspondent dated Peking, September 16:—"It is necessary to refer once again to the Shanghai river conservancy, and it is satisfactory to record that the British Government is at last interesting itself in this matter of paramount importance. It is almost certain that arrangements will be effected on the following basis:—China will ask the Powers to agree to a new protocol regarding the Shanghai conservancy in substitution for the terms of the old protocol. China will undertake to complete the work herself without any contribution from Foreign Powers. She will present a definite scheme; will appoint an engineer, whose name is to be approved by the Powers; will pledge as security the opium revenues of Sze-chuan province and Suchau prefecture; and will formally undertake that, if the work is not completed according to the terms of the new protocol, the Powers may revert to the terms of the old protocol and may go to work on the lines therein indicated, performing the work without a Chinese representative should China still refuse to nominate one. There is no reason to doubt that now that England and America are acting in conjunction the scheme can be carried to completion."

Captain George Mobsby, C.M.G., British Admiralty Pilot on the Yangtse (member of the Society of Arts), has sent the following communication, and also copies of a correspondence which has appeared in the *North China Daily News*:—

The importance of this subject deserves more than a passing notice, inasmuch as it bears so largely on the British shipping industry and our interests in trade generally with China.

It is not too much to say, that eventually Shanghai will cease to be a shipping port unless something is done to remove the Woosung bars and conserve the Huangpu generally.

The British shipping industry, and the local as well as the commercial interests of this great emporium of trade, is surely worthy of some consideration in this great matter of conservancy.

For forty years the Chinese Government have made promises to do something in the above important matter, and once they made a feeble attempt to dredge the Bar, which failed. The last arrangement made was in the XIth Clause of the Protocol of 1900; even after making this solemn treaty with the Powers, they are still obdurate.

The Woosung Bars have been the cause of delay, expense, and worry to all shipping interests since the port of Shanghai has been opened to trade. Volumes have been written on the subject, expert opinions, surveys and engineering schemes, we have abundance of during the last thirty years, so much so that it has become an established fact in the opinion of these experts that a successful conservancy scheme can be carried out. But no! Apathy reigns supreme.

It is strange that whereas in the recent treaties made with China some commercial matters, such as tariffs, trade marks, &c., changes and modifications are brought about to suit the trade and those concerned, the shipping interest is almost entirely ignored or left in abeyance. Most practical men would have thought that the new Yangtse regulations would have caused the removal of the antiquated and vexatious regulation of the River Pass. All home and coasting steamers lose time—anywhere from a day to a few hours sometimes—through the ridiculous method of applying this regulation.

When one thinks of the great part British shipping has taken in the building of the British Empire, and of the importance of holding our own against all comers, including subsidised competition as here in the East, one would naturally expect to find our shipping industry and interests jealously guarded against undue charges and unnecessary delay, through faulty regulations of the Chinese Customs Service, and the general apathy and opposition by the Chinese Government and others in the matter of this scheme of conservancy of the Huangpu.

The editor of the *North China Daily News* published the following remarks in the number for July 15th as an introduction to the petition of the Riparian landowners to the Commissioner of Customs at Shanghai in favour of immediate action for the improvement of the river. To the petition was appended a letter of approval from most of the provincial steamship agencies in the port.

* The late private *fabbriche* of the *Provincia di Siena* are noticed in the third lecture, of which the subject is "Cafaggiolo and the Later History of Ceramics in Tuscany."

"We have insisted so often on the urgency of this question, pointing out how our once noble river is deteriorating from day to day, owing to the indifference of the Chinese authorities, and the apathy of many of the foreigners most directly concerned, who comfort themselves with the thought that it will last their time and that posterity can look after itself, that we fear our readers must be tired of the subject. The united wisdom of the diplomatic body at Peking did succeed in getting a provision for the improvement of the Huangpu inserted in the Peace Protocol; but their united efforts since have not succeeded in getting the successive Viceroys at Nanking to take the necessary step to make the provision effective, and the deterioration of the river goes on unheeded. The present Viceroy has recently put forth a proposal that he shall do the work himself at his own expense, a proposition that has been generally favourably received; but another and very practical scheme is now proposed."

In the following number a letter by Sir Charles J. Dudgeon, late Chairman of the Chamber of Commerce at Shanghai, was published, which, while supporting the views of the editor, condemned a patchwork policy and asked for the carrying out of a complete scheme, referring at the same time to Mr. de Rijke's reports. Mr. de Rijke is a Dutch engineer who has made several surveys of the Huangpu since 1874.

In respect to the schemes of the riparian owners and Mr. de Rijke, Mr. Mobsby wrote as follows to Mr. F. R. Rogers, the representative of the riparian owners:—

"I will in the first instance state that my opinion is entirely with Mr. de Rijke in the matter of the Huangpu conservancy scheme. It seems to me his No. II. scheme is far and away the best that has been brought forward. Coming from a man of his knowledge, long experience, and ability, there need be no question as to the result if his plans are carried out.

"The scheme as proposed and shown on the plan you send me appears at first sight to coincide with de Rijke's, but on carefully measuring between the lines it seems to me that the waterway is rather too much contracted, specially from the New Dock to the Old Dock, and from Pootung point up to Kinleeyuen wharf, between which points the waterway would be reduced to 1,300 feet. The modern ocean steamer, which is increasing in size yearly, say of 450 feet in length, would require 1,000 feet of swinging-room at buoy; that is, allowing a little for drift, there would then be left 300 feet, which is a very small margin, for vessels at a wharf on the one side, and anchorage for the numerous small craft such as launches, lighters, junks, &c., on the other side. By allowing 1,600 feet at the New Dock, and 1,500 feet at the Old Dock, the same width above Pootung point, and, say, 1,200 feet or so at Pootung point itself, all the useful waterway through the harbour at present would be utilised, with ample room for shipping and all small craft, which of necessity must be considered, leaving a very large portion of useless mud and somewhat of the shoalest water to be reclaimed.

"In principle I agree with you and the signatories to the scheme, subject to the modification I suggest, and I think the additional 200 or 300 feet to the width of the waterway in the scheme would give you many more supporters. At the same time, the fact must be kept in view that all this labour and expense will avail nothing unless the lower reaches of the river are attended to. When the permanent works there are completed a considerably larger volume of water will be thrown in this river, consequently the local works as suggested, with the increased scour from the additional volume of water, should keep the larger waterway clear.

"The idea of confining the waterway to a natural limit or area is in my opinion the only way to make a success of conserving the Huangpu. This is a noticeable fact on the Yangtze, and naturally must apply to the Huangpu. All the shoalest parts of the Yangtze are where the river bed is too wide and intersected with islands, such as Wade Island, Oliphant Islands, Hunter Island, Sunday Island, and many others. This is brought about by the nature of the alluvial soil, which is mostly of a sandy nature, and easily moved by the action of the current. In all parts of the Yangtze, where the banks of the river are of a more solid nature, the water has cut itself a channel with area just sufficient to carry off the usual volume of water. In these parts there is usually no change in the river bed, and the channel is always good. The same natural fact applies higher up amongst the gorges; the continuous current has cut away the soft lime and sandstone till it has found the natural area required. Where the substance of the rock is so hard as to resist the action of the current, there rapids are formed.

"There certainly can be no two opinions on the fact that the Huangpu is gradually and surely closing, and this process will naturally take place in the upper reaches first; and the time will come when the Huangpu will be but a creek, unless such works as proposed are soon effectually carried out. The longer the delay the greater the cost will be.

"Vice-Admiral Parker reported in June, 1842, on the capture of Shanghai by the British, that H.M. ships *Phlegethon*, *Medusa*, and *Nemesis* succeeded in ascending this river forty-seven miles above Shanghai; how far could they go to-day?"

On August 1st, Sir Charles Dudgeon answered Mr. Mobsby's letter:—

"Mr. Mobsby both criticises and discusses the scheme; what does he say? After modestly claiming some right to an opinion 'from a long experience and observation on the Huangpu and Yangtze' (a claim which we all allow him in strong form), he says:—

"(1) 'I will state that my opinion is entirely with Mr. de Rijke in the matter of the Huangpu conservancy scheme,' Mr. Mobsby adds that 'coming

from a man of his (Mr. de Rijke's) knowledge, long experience and ability, there can be no question as to the result if his plans are carried out.'

"Now what does Mr. de Rijke propose in his 'plan B'? If I have read his report rightly it seems that there are two things (passing over many other things) that he advocates. One is the cutting of Pheasant Point, and the other, even more important, the cutting of the Pootung Point. As regards the latter, Mr. de Rijke in his report says (Section 30) :—'For a number of years past foreign firms have been incomprehensibly and heedlessly allowed to build out landing stages, piers, and floating wharves, and these on the most delicate side of the convex;' other abuses, he says, are as a trifle compared with this. It would, therefore, appear (and I hope that Mr. Mobsby or other experts will correct me if I am wrong) that, in Mr. de Rijke's opinion, it is this abuse of the Pootung convex which has caused the silting in the lower concave on the same shore, and that it is our initial error as regards the treatment of the Pootung Point which brings upon us now this wholesale project of reclamation in the lower concave. May it not be that, in the acceptance of one sin we are paving the way to another.

"And I would quote more of what Mr. de Rijke says about this Pootung Point. He says :—'In a tidal river so sensitive as this, and where every bit of tide is so precious it is *always dangerous to touch a convex* (the italics are his) or to allow anything to be done along it, except with a dredging machine or an excavator, especially is this the case with such a sharp bend as the Pootung Point.'

"(2) Mr. Mobsby says that 'the permanent work at Woosung, especially from the lighthouse to the Red Buoy, as suggested by Mr. de Rijke, is a most important point of the work required.'

"I am sorry that Mr. Mobsby did not say that it was *the* most important point of the work required, and I do not think that he will quarrel with me in suggesting such alteration of his wording. Mr. de Rijke says (Section 9.) : — 'The Huangpu, as a navigable river, owes its very existence to the rising and falling of the water-level at its mouth ; without this it would be merely a drain-course of rain-water from the lagoons and surrounding district, perhaps of not more than 200 to 300 feet, with a through depth of some 3 or 4 feet.'

"(3) Mr. Mobsby says: 'The scheme as proposed, appears at first sight to coincide with Mr. de Rijke's, but on carefully measuring between the lines it seems to me that the waterway is too much contracted, specially from the New Dock to the Old Dock, and from Pootung Point up to Kinleeyuen Wharf, between which points the waterway would be reduced to 1,300 feet.' There, it seems to me, Mr. Mobsby gets to the root of the matter. Though as a non-expert I may be touching on dangerous ground I would still venture the opinion that if the work of the dredger and excavator was, as Mr. de Rijke's suggests, applied to the removal of the Pootung convex, we would have less complaint about the silting in of the lower concave, less excuse for this reclamation scheme, and less danger of the narrowing of the river which Mr. Mobsby deprecates.

"There is, however, a matter in Mr. Mobsby's letter in which I think he is hardly supported by Mr. de Rijke's report. He says that in 1842 certain British war vessels 'succeeded in ascending this river 47 miles above Shanghai,' and he asks: 'How far could they go to-day?' I have understood from Mr. de Rijke that these same warships could to-day, presuming that they were not prevented by difficulties in the river from the city downwards, do the same thing. Mr. de Rijke, in several places in his report of 1898, refers to the 'excellent condition of the river for many miles above Shanghai;' in Section 16 he says that from 'below Choeking, say 50 miles from Shanghai . . . this river as a tidal course is one of the finest I have ever seen,' and he goes on to say that (above the city) 'there are no embankments or natural banks; the shores on both sides, from 3 to 5 feet elevated above the high tide level, have the same height in the level plains. These shores, though quite steep here and there in concaves, are of clay exceptionally strong, and do not fall away. Some of the concaves, however, showed that there must have been erosion formerly, but now I do not find a single caving worth mentioning. There is thus no shifting of the river going on at present.' And again, in the same section, 'The fact that the Huangpu upwards, over a length of over fifty miles, is as yet in such a fine condition, and retains almost intact its full capacity to draw in, or inhale the incoming tide left, is of the uttermost importance to the lower river.' Surely, sir, in that there is food for reflection. Above the city, beyond the trammels of our artificial obstructions, the river remains unharmed; we have attacked nature in our treatment of the lower part of the river, and have done so without consistent plan; the result is the mess that we are in to-day. Surely then we ought to hesitate before countenancing any schemes, however plausible, of partial palliative, or further touch the river without the help of qualified expert opinion; that expert opinion we have got in Mr. de Rijke's reports, and our whole efforts should be directed towards forcing the powers that be to give effect to it."

General Notes.

Swiney Lectures on Geology.—A course of twelve lectures on "Geology: the Record and its Interpretation," will be delivered by John S. Flett, M.A., D.Sc., in the Lecture Theatre of the Victoria and Albert Museum, South Kensington, Mondays, Wednesdays, and Fridays, at 5 p.m., beginning Monday, 7th November, and ending Friday, 2nd December. Admission to the course is free.

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

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Proceedings of the Society.

THE MAJOLICA AND GLAZED EARTHENWARE OF TUSCANY.

By Prof. R. Langton Douglas, M.A.

Lecture II.—Delivered May 2, 1904.

The Majolica of Florence and the Works of the Della Robbia.

The early history of the pottery of Florence is at present very obscure. We shall learn more about it when Dr. Wilhelm Bode publishes his monograph on "Florentine Majolica," which is in preparation. The evidence at present before us only justifies us, I think, in arriving at certain somewhat negative conclusions. We know that the pottery of Florence cannot have been of any great importance before the middle of the fourteenth century for the following reasons:—First of all, we do not find mention of any decrees or prohibitions regulating this manufacture in known documents before the close of the fourteenth century, whereas at Siena such regulations were issued in the year 1262, and probably before that date. Secondly, before the close of the fourteenth century, we rarely find potters mentioned in public documents. Thirdly, we do not find in the Florentine archives any mention of glazed and painted earthenware of anything like as early a date as the period 1290-1300, in which decade such wares are alluded to more than once in the archives of Siena. Those who uphold the claims of Florence will point to the vases represented in pictures, to the fragments of early ware that have been found in Florence, to the jugs and vases bearing the city's lily badge, and, finally, to the small treatise on the art written by Benedetto di Baldassare Ubriacchi, a Florentine, at the close of the fourteenth century. But this evidence is not conclusive. It is possible that the finer wares that were used were made at the ancient *fabbriche* of neighbouring Montelupo. It was to Montelupo and not to his native Florence that Lorenzo di Pierfrancesco de Medici went, when he wished to establish a private pottery. Benedetto may have learnt his art at Montelupo. The early legend that Luca della Robbia invented the stanniferous glaze at least tends to prove that this glaze was new to his fellow-citizens, and that such potteries as there were at Florence were behind their neighbours. The Florentines believed Luca originated it because he

first made use of it in the city, and the citizens, then as ever full of local patriotism, could not conceive that any one but a Florentine could have invented the new process.

It would be strange indeed to find that Florence in the thirteenth and fourteenth centuries was a pioneer in any art. In painting, Rome and Siena first led the way; in sculpture, Pisa; in silk-weaving, Lucca; in the art of the goldsmith, once more Siena. The Florentines, like the Norman aristocracy in England, created nothing, or next to nothing — originated no new movement; they absorbed and made their own, and ultimately improved upon, the results of the pioneer efforts of their neighbours. The Florentine Guasti,* the modern historian of the majolica of his native city, admits that before the close of the Quattrocento the local potters had not attained to such fineness and whiteness of glaze, nor such harmony and variety of colouring, as their fellow-artists in other cities.†

But if the Florentines did not succeed in producing plates and jugs and pots of very fine quality, in one kind of glazed earthenware at least they stand without rivals. No greater artist than Luca della Robbia ever adopted glazed earthenware as his medium of expression. Luca, as I have already pointed out, did not invent the stanniferous glaze as the Florentines claim, but he was the first to apply it as a covering to terra cotta statues, and sculptured works in high and low relief.

Luca, as you know, was a sculptor, a chiseller of stone and a moulder of bronze and clay, but primarily a chiseller of stone. And to some of us it is a matter of regret that an art so virile ever found expression in any medium less enduring than marble—that an art so subtle in modelling had its quality somewhat weakened by the addition of a covering of creamy glaze.

Luca's greatest works are not the glazed terra cottas with which his name is most closely connected, but his marvellous Cantoria, or singing gallery, made for the Duomo of Florence, begun in 1431 and finished in 1438, the reliefs on the Florentine Campanile, begun in 1437 and finished two years later, and the reliefs on the bronze doors of the sacristy of the cathedral, commissioned in 1437, and not completed until about the year 1470.

These works reveal to us an artist who, for a Florentine, was singularly artistic. The Florentine artists were, as I have said elsewhere, seldom content to be merely artists. They were poets and humanists; they were archæologists and men of science; they were philosophers and theologians; and at times in every one of them the desire to record mere facts of the natural world or to teach some theological or philosophical dogma predominated over all purely artistic impulses. In the best of them there is a tendency to mere illustration. It is true, of course, that the scientific problems in which some of them were keenly interested were connected with certain artistic problems. It is true that their study of anatomy and of the laws of perspective resulted in the greatest service to art. But the fault of many great Florentines, from Uccello to Michael Angelo, was that they were tempted to treat their subjects scientifically rather than artistically, and to become mere scientific illustrators. Now in Luca we find no such tendency. For whilst as a man he is much inferior to the great Donatello and even to Ghiberti, as a sculptor he is more faultless, more complete. He never forgets his own vocation. He is always primarily an artist. He is also a poet; but he only seeks to express in sculpture those poetical feelings and imaginings that are suitable for plastic expression.

We cannot understand Luca as an artist in terra cotta unless we study his more important works in stone. His Cantoria is the most important manifestation of his genius. Florentines have not treated kindly this great compatriot of theirs—one of the few really great artists of the Florentine school who were born in Florence. The architectural framework of the upper part of the singing gallery was destroyed in the seventeenth century, and in the last century was incorrectly restored in stucco. Moreover, Luca's masterpiece has been placed in an unsuitable position, in a room unfitted for it in the Opera del Duomo. Nevertheless, this work is so full of charm, even in its present mutilated state, that in contemplating it we half forget what it has lost. The eight reliefs represent children singing, dancing, and playing on musical instruments. In them we find the chief qualities of Luca's art, his grace of line, his freshness, his wonderful power of representing the vitality, sanity and

* Guasti: *Cafaggiolo, e di altre fabbriche di ceramica in Toscana*, Florence, Barbèra, 1902.

† I have been successful in tracing the history of some of the early pieces of fine quality recently purchased from Florentine dealers, and which have since been called Florentine. They were bought in Siena and S. Gimignano, and are of Sienese origin. In some cases the dealers had cogent reasons for not stating whence these pieces came.

beauty of happy childhood, his admirable technique, and, above all—if we can imagine the gallery with its original framework and in its original position—the architectonic quality of his best achievement. This quality Luca possessed to an amazing degree. Take away one of his works from the place for which it was originally intended, hang it, with little regard to its lighting, the altitude of its new position and its general setting, on the walls of some gallery, and more than half its charm has gone. "Like Tuscan wine," says Pater, "it loses its savour when moved from its birth-place, and from the crumbling walls where it was first placed." And in nothing does the modern Italian show more clearly his want of artistic taste than his passionate desire to pull down the works of the Della Robbia, to label them and to put them in rows in a museum, just as though they were stuffed crocodiles or implements of the stone age.

This architectonic quality is visible in all Luca's best works. We find in them evidence of a feeling for proportion, of an instinctive sense of the relation of the parts to the whole. Now, great as Donatello was, this quality does not so entirely possess him as it did his rival, and in the achievement of Michelangelo it is sometimes obtrusively absent. And to some of us, nothing can compensate for the absence of this quality, whether in art, or literature, or life: it is the one great heresy, the cause of all other heresies.

The best qualities of Luca's art are to be found in the great work of his later life, the work in which he collaborated with Michelozzo, the bronze doors of the cathedral sacristy. He is not led astray by the brilliant artistic heresies of Ghiberti. His reliefs are not pictorial. He does not seek to give an effect of distance. His exigent sense of artistic fitness prevented him from making such an attempt. He realised first of all what he was doing, and the place it was to occupy. He was making a door; and on a door, as on a floor, feats of perspective are out of place, and do not harmonise with the character of the thing they decorate. Secondly, he realised the artistic effects that could be best produced in his medium. Thus far the reliefs on these doors are in accord with the rest of Luca's achievement. But there is something in them that is not entirely of Luca. These ten beautiful panels, in each of which is a saint attended by angels, show more severity, more restraint than the reliefs of the Cantoria. That they do so is due, no doubt, to the fact that Michelozzo had an important share in the designing of them. Few artists of the Renaissance are more imbued with the classical spirit than Michelozzo, and to him, I think, must be given the design of the doors as a whole. This conclusion does not accord with the opinion of Luca della Robbia's latest biographer, who has a full measure of the biographer's kindly bias, but there is, nevertheless, overwhelming evidence in its favour. In the first place, Michelozzo's name appears first in the document of commission. Secondly, the same document states that at the time it was written the model of the doors was at Michelozzo's studio. Thirdly, for stylistic reasons we must give the general design to Michelozzo. I will give but two of these reasons:—(1) Had Luca designed these doors he would have given them a more decorated border. His fondness for such borders amounted to a passion, and marred some of his severest and noblest work. How out of place is the very pretty border of painted tiles which frames the monument of Benozzo Federighi in the Church of the Trinità! How tawdry and incongruous is the border upon the base of the tabernacle at Peretola! (2) The general design of these sacristy doors has that pure, classical character that we find in the portal of the Novitiate at S. Croce and in the tabernacle of the Merchants at Or San Michele.

It must be confessed, indeed, that Luca's sense of artistic fitness, manifest as it is in his best work, sometimes failed him. Had he understood fully his art and his own qualities as a sculptor, it is probable that we would have had no statues and reliefs in glazed terra cotta from his hand, but many more masterpieces in marble and bronze. Seeing that Luca understood so well his medium and its capabilities, seeing, too, that his work in bronze and marble is so remarkable for fineness of execution, it is strange that he ever applied himself to the process with which his name is indissolubly connected. For indeed glazed earthenware is not a suitable medium for the highest form of sculpture. If a figure moulded by an artist is afterwards covered with a glaze, some of the peculiar virtues of his work must be lost. It cannot have the same qualities of surface as works executed in marble. It cannot convey so finely, so subtly, so directly, the artist's thought and emotion, the touch of the master's hand. Again, figures and architectural decorations in terra cotta can never have the same structural

quality as similar works executed in marble; they can never give us the same sense of strength, of stability. And yet the æsthetic observer gets so much pleasure from the contemplation of these works of Luca that it seems ungracious to complain that, because of the defects of the medium, we do not get more.

Luca first employed glazed and painted terra cotta merely as a decorative accessory to sculpture. His tabernacle, now in the Collegiata at Peretola, is the earliest work in which he made use of earthenware the date of which is known. This tabernacle was made for the chapel of St. Luke in the hospital of S. Maria Nuova, Florence, in the year 1441. It was transported to the chapel belonging to the hospital in the remote Tuscan village in the seventeenth century—an age that was not in sympathy with the art of Luca. Only the angels' heads and the garlands on the frieze above, the base of the tabernacle, the background of the Pietà, and the spandrels of the roof, are decorated with coloured terra cotta of blue and white and green. These patches of colour and flimsy material do not accord well with the sculpturesque severity and dignity of the rest of the work.

Luca seems to have realised that this attempt to combine glazed earthenware and marble was not altogether successful, for in his next important piece, the "Resurrection" of the Duomo, he employed terra cotta alone. This, though one of his earliest, is one of his finest works in this medium. In the whole of art there are few nobler conceptions of the Christ than in this relief. The figures, too, of the sleeping soldiers are admirably realised. This relief decorates the tympanum above the door of the Sagrestia Nuova. Above the door of the other sacristy, the Sagrestia Vecchia, is Luca's "Ascension," executed in 1446, three years after the "Resurrection," a work not quite as fine in quality as the "Resurrection," but which, nevertheless, takes rank with the best of Luca's reliefs. The groups of kneeling Apostles are admirably designed and the individual forms are well modelled.

Another important work of this period was the decoration of the Pazzi Chapel at S. Croce. There Luca co-operated with Filippo Brunelleschi to make one of the most beautiful works of the early Renaissance. The roof of the atrium, its frieze and architrave, the medallions of the four Evangelists on the interior of the ribbed dome, the frieze of lambs with the medallions of the twelve Apostles underneath, combine to make a beautiful decoration to a beautiful building.

Some of Luca's most important works in glazed terra cotta are to be found in the little village of Impruneta, six miles south-west of Florence. There is kept the wonder-working image of the Virgin, which, in times of pestilence or other public calamity, it was customary to carry in procession to Florence. Near to the chapel which contains the sacred image is the Chapel of the Holy Cross. In both these chapels Luca again worked in collaboration with Michelozzo. The structure of both of the oratories and the tabernacle of the chapel of the Madonna, are by Michelozzo. The rest of the decoration of this chapel, internal and external, and the tabernacle and decorations of the other chapel of the Holy Cross, are by Luca. His most important work at the Impruneta is this last tabernacle, the tabernacle of the Sacrament, to give it its proper title. For the chapel was formerly dedicated to the Blessed Sacrament, and the relief of the "Crucifixion," now in an adjoining chapel, once occupied the place of the cupboard which the tabernacle now encloses. The relief was removed in the seventeenth century, and a portion of the Holy Cross was placed in the recess of the tabernacle where the "Crucifixion" had formerly stood.

We will consider the work in its original complete state. It is full alike of the merits and defects of Luca's work. The tabernacle itself is very inferior to the tabernacles of Luca's great collaborator Michelozzo. Elaborate decoration does not befit a framework of this kind, and we look in it, too, for more harmony of pattern and design than we find in this tabernacle, in which there is little artistic relation between the decorations of the frieze, the pilasters, and the base. With the tabernacle itself censorious criticism ceases. The statues that flank it, the "Crucifixion" it framed, and the angels on the relief below, are all worthy to rank with Luca's noblest works in glazed earthenware. The "Crucifixion" finely conveys to us the artist's emotions in contemplating the story of the Cross.

Some critics who imperfectly understand the psychology of art seem to think that to call a work of art emotional is to condemn it. Emotion that is either exhaustive, or shallow, or merely conventional and imitative, is certainly unsatisfactory whether in art or in life, but sincere and subtle emotion it is the first business of the artist to convey. Emotionless

art is a contradiction in terms, for art is primarily the ordered, rhythmic expression of emotion. Luca's treatment of the Crucifixion, therefore, is emotional. It is the veriest affectation to represent the Virgin or St. John, or the attendant angels as other than powerfully, nay, terribly moved at the sight of the Son of God in his death-agony, at the sight of their Lord crucified. To Luca, at least, the event was very real and terrible, and he has not shrunk from giving us his conception of it. Had it only been in sensitive marble instead of glazed earthenware, it would have been one of the most poignant as well as one of the noblest representations of the event that the world has seen. The difference between a marble statue and a glazed statue is the difference between the touch and appearance of an ungloved hand and a gloved hand. In Luca's own works the envelope is always thin, even, and of beautiful quality. But though the glove may be well-fitting and of fine material, we had rather see and touch a beautiful hand ungloved than gloved. Nevertheless in the presence of the masterpiece we forget the artist's mistake in the choice of his material. The fine but not too obtrusive modelling of the figures, the vitality and movement of the angels and the young St. John, the face of the Christ—all compel our enthusiastic admiration.

Beautiful, too, and light-poised, and swift in flight, are the angels that guard the shrine of the sacrament below the tabernacle. And "St. John the Baptist," and "St. Augustine," the finely-modelled figures who guard the tabernacle on either side, are full of noble solemnity as they contemplate the subject of the Crucifixion. Their calm is the calm of men who, whilst solemnized by the thought of mankind's sin and its penalty, know that the triumph of the Resurrection followed the Crucifixion. The emotion of the actual spectators of the event is also natural; in that they did not see the tragedy's victorious issue.

As I have only time to refer to two of Luca's Madonnas, I will choose the "Madonna of the Roses" and the "Madonna of the Cappella Bertolo," the first because it is one of the most characteristic of Luca's works, the second because it illustrates the transitional period of the art at the close of Luca's long life. The "Madonna of the Roses" is one of the most sympathetic of Luca's representations of the Virgin. It reminds us of the part that Luca played in the humanizing of the type of the Madonna. In his works, as in Fra Angelico's, we see a gradual progression. His conception of the mother and the child becomes more and more human, tender, and pathetic without being less divine. The mother grows more maternal, the child more child-like, as his art advances. In the "Madonna of the Roses" the Virgin looks tenderly at the child as he plucks one of the flowers. There are representations of the Madonna of Luca's last period which are even more tender, more intimate than this. But stylistic as well as iconographical reasons make it impossible to agree with those critics who regard it as an early work. It belongs to the master's middle period, and is certainly later in date than the Urbino lunette. "The Madonna of the Cappella Bertolo" is a work of the master's old age. Contemplative, and a little lacking in vitality and spontaneity, it has nevertheless the qualities of Luca's authenticated works. The frame of leaves and fruits, the background, the hands of the Almighty and the Holy Dove are the work of Andrea or some other assistant.

Luca's works in glazed earthenware have technical qualities which are not possessed by any other works of the class except those of Andrea's best period. In the first place, he uses a glaze of creamy whiteness, which is free from all impurities. Secondly, in his works the glaze is thinly and evenly distributed over the whole surface. Thirdly, he was careful in mixing and refining the paste of the body of his pieces. That the surface of his glaze is free from bubbles or spots is not entirely due to the quality of the glaze, as some of his biographers have stated who are not sufficiently acquainted with the technique of the process. It is due, in a measure, to the fact that the body was made of selected clay, well washed, beaten, and kneaded, and freed from all impurities. Fourthly, he is scrupulously careful in other matters of detail, in the joinings of the different parts of his relief, in his frames of fruits and leaves. There is no merely mechanical work. In the borders of his *stemmi* we find that he never repeated a section. He was never content with merely mechanical reproduction.

Andrea della Robbia was born in the year 1433. During his early years he was an assistant of his uncle Luca, and was always strongly influenced by him. But he was no mere imitator. He had a distinct artistic personality, which revealed itself long before Luca's death; and perhaps, for his genius, glazed earthenware was a more suitable means of expression than it proved to be in the case of Luca. His

earliest independent works are the decorations of the Loggia of the Hospital of the Innocents, which were executed between the years 1463 and 1465 when Andrea was thirty years old. While he was at work upon them, he married a young Florentine girl, who bore him three children before she was twenty-one years old. Let us hope that they were as charming as his earlier offspring, the lovely infants that still look down upon us from the façade of the Innocenti. No more tender, more poignant, more intimate representations of childhood are to be found in the whole range of art than these babies, who for four and a half centuries have pleaded for alms to those who have passed along the piazza to the church dedicated to the Virgin of the Annunciation.

Andrea della Robbia is best studied at La Verna. There are no less than fifteen works of the Robbia family in the great hill-set convent redolent with memories of St. Francis of Assisi. Amongst them are four masterpieces of Andrea. Perhaps the most perfect of them is the "Madonna of the Girdle," executed about the year 1480. The Virgin has that charming, essentially feminine and maternal character which we see in all his representations of her. Below the Madonna kneel the four noble figures, St. Thomas, St. Gregory, St. Bonaventura, and St. Francis. The predella is an imitation, but an artistic, not a slavish imitation, of the predella of the tabernacle of the Holy Cross at Impruneta, which I have lately described. The St. Thomas is one of the most finely realised, finely executed figures in the whole range of the art of the Robbia.

A stronger but more faulty work is Andrea's colossal "Crucifixion," in the chapel of the Stigmata. In this work, the introduction of colour in the glaze of the central figure is a distinct mark of decadence. But the "Crucifixion" of La Verna is a later work of Andrea. Some of the pieces that he executed immediately after completing his earlier masterpieces at La Verna are amongst the best of his works. "The Madonna and Saints" in the Cappella Medici at Santa Croce is known to every visitor to Florence. The faces of the saints, so full of devotion and tenderness, are most delicately modelled. The St. Francis is a finely realised figure, full of pathos and character. The frieze decorated with cherubs' heads, too, contrasts pleasantly with the solemnity of the Virgin and the attendant saints.

A fine work of Andrea, which has suffered very unkind treatment, is the "Madonna of the Architects," in the Museo Nazionale. The group of the Virgin and Child is amongst the best of the master's works. In feeling, in design, and in its technical qualities, it recalls Luca's own work, and especially his two little Madonnas at the Impruneta. But it has a very heavy, ill-designed frame, and is placed in an unsuitable position in the Museo Nazionale. Perhaps the most distracting feature of the small tabernacle are the heads of cherubs on the inside, which very much mar the effect of the central group. It seems to me that this frame was made at a later date than the Madonna by Giovanni della Robbia.

With Andrea the decline of the art began. In his later years he employed many assistants, who repeated his designs, and often executed slovenly work of the poorest technical quality. In place of the fine, flawless, cream-coloured glaze of Luca, and of such works of Andrea as the Madonna della Cintola at La Verna, we get a white glaze of poor quality, whose surface is coarsened by specks of dust or grit, by bubbles and flaws. Consummate artist as he was, Andrea degraded his art by sending from his crowded *bottega* cheap, hurried work in response to a popular demand. Under his son Giovanni its degradation became complete.

Giovanni della Robbia, the third son of Andrea, was born in 1469. He was not without ability or even genius; but he was commercially minded, and without artistic conscience. He loved crude, loud effects; and when once he ceased to imitate his father, he showed a tendency towards unrestrained realism, and a love for bizarre effects of colour. In some respects he was the very antithesis of his father. In place of Andrea's sympathetic, tender, gentle art, with its beautiful representations of motherhood and childhood, we are given work which is full of types whose chief quality is their rude strength. His lack of artistic conscience led him to neglect the careful preparation of the clay and the glaze, to admit mechanical repetitions of patterns and sections of patterns, and to be careless in putting together the component parts of a relief or an altar piece. In his later period, in place of the white glaze he adopted glazes of various colours, and in his latest work substituted oil paint for glaze. His object seems to have been to obtain a striking effect with as little labour as possible. Nevertheless, Giovanni, in spite of his failings, succeeded in

producing a few works of high artistic quality; and, in using glazed earthenware for purely architectural decoration, he was working on right lines. His masterpieces were his earliest independent work and his latest, the lavabo of S. Maria Novella, and the frieze of the Ospedale del Ceppo at Pistoja.

The lavabo is a work of singular charm, a graceful composition in which colour is used judiciously. Every part of it is well designed, the frieze, the reliefs on the pilaster, the beautiful painted landscape, and the font below. Moreover the lavabo is admirably adapted for its purpose. In this work, which is proved by documentary evidence to be from Giovanni's hand, the master excels both as a painter and a sculptor. Giovanni affords a striking example of the ineffectiveness of high artistic gifts when they are not combined with an exigent taste and a sensitive artistic conscience.

His tabernacle in the Via Nazionale at Florence shows to what depths he was capable of sinking. An over-crowded, ill-composed piece, tawdry and inharmonious in colour, and vulgar in sentiment, there it has stood in the public street for well-nigh four centuries, testifying to the degradation of its author.

In his last known work this surprising artist succeeded in getting out of himself another masterpiece. The decoration of the Ospedale del Ceppo has certain obvious faults. Neither the design nor the colour-scheme is harmonious, and yet the work as a whole is effective. The actual execution is by more than one hand, but the whole credit of the design may, I think, be given to Giovanni della Robbia. The chief element of the decorative scheme is a frieze consisting of seven reliefs representing the seven corporal works of mercy, with one of the seven cardinal virtues dividing each of the reliefs from its neighbours.

The treatment of the subject is singularly realistic. In the "Clothing of the Naked" we note the fine modelling of the half-nude figures to the left, and in the "Visiting the Prisoners" we also note some finely realised figures. No photographic reproduction of parts of the design can give any idea of the rich, bizarre, finely barbaric effect of the whole work.

Giovanni died in the year 1529, only a year after his father, who lived to the age of ninety. Andrea's youngest son, Girolamo, lived for the greater part of his artistic career in France, and of his great work, the Château de Madrid, a building entirely encrusted with glazed and coloured earthenware, only a few fragments remain.

Among the many assistants of the Della Robbia who were not of their family, the name of the most important that has reached us is that of Benedetto Buglioni. Vasari mentions him in his "Life of Verrocchio" as a worker in glazed terra cotta, who had learnt his secret from a woman of the family of Andrea della Robbia. The researches of Milanesi demonstrated that he was an assistant of Giovanni della Robbia, and that he executed independent works in Florence, Genoa, Perugia, and Pistoja. In Pistoja one of his pieces remains, a "Coronation of the Virgin," over the entrance of the chapel of the hospital. In Florence, on the façade of the church of Ognissanti, is a tympanum decorated with a large relief of the "Coronation," a work known to all visitors to the city. This relief is now given to Buglioni, because of the strong similarity the principal group bears to the lunette at Pistoja. The resemblances are numerous and obvious—so obvious that it would be mere useless pedantry to detail them. And yet I am not convinced that the relief on the Ognissanti is by Buglioni. The composition at Pistoja consists only of the two principal figures, and of eleven cherubs' heads. At the Ognissanti we see a choir of angels round about the Christ and the Virgin, and below them a row of seven saints. Both the angels and the saints are most characteric works of Giovanni della Robbia. So obviously is this the case that it would again be mere pedantry to make a list of morphological similarities to his work. Is it likely that if Giovanni had executed all the subordinate figures, he would have entrusted the principal figures to an assistant? I think not. Moreover, the principal figures are obviously by the same hand as the rest of the piece. I conclude that this "Coronation" of the Ognissanti is by Giovanni della Robbia, and that Buglioni's lunette at Pistoja is a pupil's free copy of his master's work.

During the period of the Della Robbia, a period of a hundred years, from the year 1430 to 1529, the date of Giovanni's death, majolica in the ordinary sense of the term was doubtless produced in Florence. But neither documentary evidence nor the evidence of signed pieces points to the conclusion that the local *fabbriche* were of great importance. The Della Robbia themselves made, as we have seen, a decorative use of painted tiles and plaques of glazed earthenware, large and

small. Criticism no longer allows that the paintings of the "Months" in the Victoria and Albert Museum are by Luca. But the border of the "Tomb of Benozzo Federighi" is composed of tiles decorated with beautiful paintings of flowers—lilies and roses and marigolds, and on the base of the tabernacle of the Sacrament at the Impruneta, are groups of pine-cones and leaves from Luca's brush. Giovanni, as we have already seen, decorated the lavabo of S. Maria Novello with a landscape painted with singular mastery on a large tile. It is strange that with such influences at work in Florence the art of majolica did not develop more rapidly. That Florence was not, at the close of the fifteenth century, a great and progressive centre of the art is demonstrated, not only by the fact that there is scarcely one important piece of that period that was indisputably executed in Florence; but also by the solicitude of Lorenzo di Pierfrancesco de' Medici, a cousin of the great Lorenzo, to establish artistic potteries in the city by importing artists from other towns. The *fabbrica* he founded was soon removed to Cafaggiolo, and Florence did not become a place of importance in the history of ceramics until the new porcelain was made there in the days of the Duke Francesco.

Miscellaneous.

*GLACIER-BURSTS.**

Glaciers give rise to torrential phenomena known by the name of "débâcles," or glacier-bursts, the geological importance of which has hitherto been insufficiently recognised.

The production of an outburst depends on the prior creation of a reservoir of water and its sudden discharge. The creation of this reservoir may be the result of an advance or retreat of the glacier, which has the effect of stopping the outflow of the waters into a *thalweg;* it may equally be the consequence of the present state of the glaciation, which may permanently block the valley. Lastly, the body of water necessary to the production of an outburst may be formed either above or below the glacier, or even within its thickness. When the barrier of ice yields the outburst takes place, and its violence is proportional to the cubic contents of the reservoir and the slope of the ground over which the inundation passes. In the Alps, twenty-five glaciers have been the scene of outbursts, either singly or in series, whose causes are matter of knowledge, but many others have produced inundations whose mode of origin has escaped observation. The total number is certainly much greater, but only the most destructive have been recorded prior to 1892, the date of the Saint Gervais catastrophe.

These torrential phenomena occur in all the glaciated mountain regions of the world—in Norway, Iceland, Spitsbergen (where Sir Martin Conway and Mr. E. J. Garwood have noted their effects), in Greenland, Alaska, and, lastly, in the Himalayas. In the last-named region English travellers, like Col. Godwin-Austen, Sir Martin Conway, and Professor Norman Collie, have collected valuable data bearing on this phenomenon. In the Alps, the volume of water precipitated in the case of destructive outbursts may reach several million cubic metres, and this enormous liquid mass may flow away in a few hours over steeply sloping ground. In 1878, the Marjelensee discharged 7,700,000 cubic metres in nine hours, and the Gietroz outburst in 1818 attained a volume of 530 million cubic feet.

Such a mass of water moving at an enormous speed has an important erosive effect, and modifies the contours of the valley along which it takes its course. On the other hand, it carries with it enormous masses of material, and, frequently, large numbers of trees. All these *débris* are afterwards deposited in the locality, where a diminution of the angle of slope brings about a reduction in the rate of flow. Thus, in valleys visited by frequent catastrophes, we may say that the glacial deposits of the present day, or of Pleistocene age, have been, and are still being, shifted and rearranged throughout the whole of the zone affected by these wild waters. Similar inundations must necessarily have been very frequent during the glacial epoch, and frequent mistakes must have been made in studying the Pleistocene formations through not taking account of these phenomena. Still, we must not go too far and exaggerate the action of glacier outbursts. Their effects are at the present day limited to the sides of the *thalwegs*, and the same must have been the case during the Quaternary period.

* Abstract of a paper read by Charles Rabot before Section E of the British Association at Cambridge.

*ELECTRIC WAVES, AND WIRELESS TELEGRAPHY.**

This paper is concerned with an experimental and theoretical treatment of the propagation of electric waves along spiral wires. The subject has engaged the attention of several physicists. Hertz has described an experiment in which he established

* Abstract of a paper read by J. A. Fleming, M.A., D.Sc. F.R.S., before Section A of the British Association at Cambridge.

stationary electric waves on a spiral wire, and compared the distance of the nodes with the corresponding distances when the wire was stretched out straight. Theoretical treatment has been given by H. C. Pocklington, and G. Siebt has provided lecture apparatus for exhibiting the propagation of stationary waves on spiral wires.

The first experiments described by the author were made with a long helix of insulated copper wire, wound in one layer on a wooden rod. The helix consisted of 5,000 turns, the length being 200 centimetres. If such a helix is placed in connection with an oscillating circuit consisting of a condenser or Leyden jar, a spark gap and a variable inductance, stationary waves could be set up on the helix by adjusting the inductance in the oscillating circuit. In order to detect the nodes and antinodes of these stationary oscillations, the author makes use of a vacuum tube, similar to that used in spectrum analysis, preferably one filled with the rare gas, Neon, which was kindly supplied to him by Sir William Ramsay. Rarified Neon seems to be extremely sensitive to the presence of variable electric force through it; hence, if such a tube is held perpendicular to the helix and moved parallel to itself along it, it glows brightly at the antinodes, but not at the nodes. In this manner the internodal distances can be measured with considerable accuracy, and the wave-length of the stationary oscillation measured.

The paper also contains a theoretical analysis of the phenomena leading to the conclusion that the velocity with which the wave is propagated along the spiral is inversely proportional to the square root of the product of the capacity and inductance of the helix per unit of length. The author has perfected of late years methods for measuring very small capacities aud inductances, and in the case of the above-named helix the inductance is equal to 100,000 centimetres per centimetre, whilst a capacity of the helix is $\frac{7}{40}$ of a micro-microfarad. (1 micro-microfarad $=$ 10^{-6} microfarad.)

From these data the propagation of electric waves along the helix can be shown to be 235,000,000 centimetres per second. This figure is confirmed in the following manner:—The capacity and the inductance in the oscillating circuit are both measured when the first harmonic oscillation is formed on the helix, and under those conditions the half-wave length was found to be 140 centimetres, whilst the frequency in the oscillating circuit, as calculated from the capacity and inductance, was found to be $0 \cdot 847 \times 10^6$. Having, therefore, the wave-length and frequency, we find their product gives a velocity of 235,000,000 centimetres per second, which agrees with the figure determined from the constants of the helix.

It is shown in the paper that the best form of inductance to be employed in connection with the oscillating circuit is a square of one turn of wire, and that the employment of spiral coils leads to errors due to passage of a dielectric current from coil to coil. On the above lines an apparatus has been devised by the author for measuring wave-lengths in connection with Hertzian wave wireless telegraphy. It is a matter of considerable importance to be able to determine the frequency and wave-length of the waves sent out by any given transmitting arrangement.

The author calls this instrument a "Kummeter." It is constructed as follows:—A long ebonite rod is wound over closely with silk-covered wire in one layer, and this is supported on insulating stands. On this long helix slides a metal saddle having some layers of tinfoil interposed to make good contact between the saddle and the helix. This saddle is connected by a flexible wire with the earth. One end of the helix is furnished with an insulated metal plate, which is placed in apposition to another metal plate fixed to the oscillating surface of the transmitter. The process of measuring the wave consists in sliding the saddle along a Neon vacuum tube, indicates the presence of one node halfway between the saddle and the plate. When this is the case the distance from saddle to plate is one wave-length of the stationary wave on the helix.

From the constants of the helix the velocity of the wave along it can be calculated as above shown, and hence the frequency of the oscillating circuit becomes known. If this frequency is divided into the velocity of light, reckoned in feet, it gives the wave-length in feet of the wave radiated from the associated aërial, provided that the aërial radiating wire has been tuned to be in resonance with this oscillating circuit. This instrument also provides the means of measuring small inductances, and also the frequencies in oscillating circuits, which are much higher than those which can be determined by photographing the spark.

ADMIRALTY CHARTS.

The following is the official list of charts issued by the Hydrographic Department of the Admiralty in July and August last:—

New Charts.—No. 1683—England, west coast; Padstow harbour. 1919—Scotland; Hebrides, Lewis island: — Stornoway harbour. 3400 — England; Channel islands:—Guernsey, Herm, and Sark. 3442—Lapland; plans on the north coast of Russian Lapland:—Ivanovski bay. 3435—Sweden; plans on the east coast:—The narrows of Kalmar sound; entrance to Gefle; entrance to Umea. 3414—France, south coast:—approaches to Marseilles. 2285—Black sea; Varna:—Baljik bay. 3406—Newfoundland, east coast:—Bay of Exploits, Sheet I. (North). 3417 — British Columbia; Vancouver island:—Hanson island to Beaver harbour, including Broughton strait; Port McNeill. 3431—Africa, west coast:—Cape Coast Castle to Barako point. 3432—Africa, west coast:—Barako point to Great Ningo. 3423—Africa, west coast:—Old Calabar river, Duke town anchorage. 3370—Philippine islands:—San Bernardino strait and approaches. 3429—China,

east coast; Hong Kong island:—East Lamma channel. 3437—Japan; Nipon, west coast:—Hagi approaches. 431 — Australia, west coast:—Swan river, North Fremantle to Perth. 1347 — Peru; plans on the coast; plan added:—Huacho anchorage. 632—Africa, west coast; Walfisch bay to Orange river; plan added:—Prince of Wales bay. 1341—Eastern archipelago; anchorages on the north coast of Java; plan added:—Tegal road. 1023—China, south coast; Boddam cove; plan added:—Nam sha bay. 1256—China, north coast; Gulfs of Pe chili and Liau tung; plan added:—Sketch of entrance and bar of the Yang kiao ko.

Charts that have received additions or corrections too large to be conveniently inserted by hand:—Nos. 1188—The World:—Coal and telegraph chart. 34—England, south coast:—The Scilly Isles. 1765—Ireland, south coast:—Queenstown and port of Cork (outer sheet). 1777—Ireland, south coast:—Queenstown and port (inner sheet). 3384—Ireland, south coast:—Queenstown. 2246—Baltic sea:—Port Baltic to Hogland. 2694—France, west coast:—Channels between Ile d'Ouessant and the mainland. 2554—Mediterranean Sea; Italy:—Leghorn roadstead, &c. 2379—Black Sea:—Kherson Dnieper bay. 893—Newfoundland:—Burin harbour to Devil bay. West India islands and Caribbean sea, sheet 1. 762—West Indies:—Jamaica and the Petro bank. 1274—Gulf of Mexico:—Tortugas cays to cape San Blas. 23—Chile:—Channels between Magellan strait and gulf of Trinidad. 631—South America, west coast:—Smyth channel from south entrance to Fortune bay. 1840—British Columbia:—Haro strait and Middle channel. 759a—Madagascar:—Cape St. Andrew to Bevato island. 821—Bay of Bengal:—Elephant point to Cheduba strait. 833—Bay of Bengal:—Rangoon river and approaches. 2153—Malacca strait:—Port Swettenham. 928—Sulu archipelago. 2577—Philippine islands:—Between St. Bernadino and Mindoro straits. 3283—Philippine islands:—Port Salomague and approach; port Sual. 127—Japan:—Hirado no seto to Simonoseki strait. 1674—Australia, east coast:—Brisbane river. 2614—New Zealand:—Kaipara harbour. 2540—New Zealand:—Awarua or Bluff harbour and New river. 3044—Celebes:—Ujong Jonga to Ujong kassi.

These charts are issued by Mr. J. D. Potter, 145, Minories.

General Notes.

HOUSES OF HISTORIC INTEREST.—At the meeting of the London County Council, held on the 25th October, it was agreed, upon the recommendation of the Local Government and Records Committee, to affix a memorial tablet at No. 23, Suffolk-street, W., where Richard Cobden lived. The committee reported that the Duke of Bedford had fixed tablets at his own expense at the following houses on his estate:—65, Russell-square (Sir Thomas Lawrence), 11, Bedford-square (Henry Cavendish), 6, Bloomsbury-square (Isaac D'Israeli), 28 and 29, Bloomsbury-square (Lord Mansfield), 43, King-street, Covent-garden (Admiral Lord Orford), 27, Southampton-street, Covent-garden (David Garrick).

MEETINGS FOR THE ENSUING WEEK.

MONDAY, OCT. 31...Farmers' Club, 2, Whitehall-court, S.W., $3\frac{1}{2}$ p.m. Mr. C. Harris Stratton, "An Outsider's View of the Management of Local Affairs by County Councils."
London Institution, Finsbury-circus, E.C., 5 p.m. Lord Avebury, "Our Fiscal Policy."

TUESDAY, NOV. 1...Central Chamber of Agriculture (at the HOUSE OF THE SOCIETY OF ARTS), 11 a.m.
Civil Engineers, 25, Great George-street, S.W., 8 p.m. Opening Address by the President, Sir Guilford Molesworth, and Reception.
Horticultural, Vincent-square, Westminster, S.W., 1 p.m. Exhibition of Autumn Flowers; 3 p.m., Lecture.

WEDNESDAY, NOV. 2...Royal Archæological Institute, 20, Hanover-square, W., 4 p.m. Mr. W. H. St. John Hope, "Some Notes on the Abbey Church of Glastonbury."

THURSDAY, NOV. 3...Tramways and Light Railways Assoc. (at the HOUSE OF THE SOCIETY OF ARTS), 8 p.m. Mr. A. N. Connett, "Notes on Permanent Way."
Chemical, Burlington-house, W., $5\frac{1}{2}$ p.m. 1. Messrs. J. B. Cohen and J. Gatecliff, "Note on the Action of Nitric Acid on the Ethers." 2. Mr. E. A. Werner, "The Condensation of Formaldehyde with Acetone." Preliminary Note. 3. Mr. J. W. Mellor, "Union of Hydrogen and Chlorine.—Rate of Decay of Activity of Chlorine." 4. Messrs. S. S. Pickles and C. Weizmann, "The Action of Phthalic Anhydride on α naphthyl-magnesium-bromide." 5. Mr. O. Silberrad, "The Constitution of Nitrogen Iodide." 6. Mr. H. Ingle "The Available Plant Food in Soils." 7. Messrs. W. A. Bone and R. V. Wheeler, "The Combustion of Ethylene." 8. Mr. C. E. Fawsitt, "The Decomposition of Methelurea." 9. Miss E. G. Willcock, "The Influence of Certain Salts and Organic Bodies on the Oxidation of Guaiacum." 10. Mr J. A. N. Friend, "The Influence of potassium Persulphate on the Estimation of Hydrogen Peroxide." 11. Messrs. R. S. Morrell and E. K. Hanson, "The Dynamic Isomerism of α and β Crotonic Acids." Preliminary note. 12. Mr. W. A. Caldecott, "The Influence of Sunlight on the Dissolving of Gold in an Aqueous Solution of Potassium Cyanide." 13. Mr. H. D. Dakin, a. "The Fractional Hydrolysis of Amygdalinic Acid." b. "Isoamygdaline."
London Institution, Finsbury-circus, E.C., 6 p.m. Sir Robert Anderson, "Crime and Criminals."
Camera Club, Charing-cross-road, W.C., $8\frac{1}{4}$ p.m. Lecture by the President, Sir William Abney.

FRIDAY, NOV. 4...Art Workers' Guild, Clifford's-inn Hall, Fleet-street, E.C., 8 p.m.
Geologists' Association, University College, W.C., 8 p.m. Conversazione.

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FRIDAY, NOVEMBER 4, 1904.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

ARRANGEMENTS FOR THE SESSION.

The First Meeting of the One Hundred-and Fifty-First Session will be held on Wednesday evening, the 16th of November, when an Address will be delivered by Sir William Abney, K.C.B., D.C.L., D.Sc., F.R.S., Vice-President and Chairman of the Council.

Previous to Christmas there will be Five Ordinary Meetings, one meeting of the Indian Section, and one of the Applied Art Section. The following arrangements have been made :—

Ordinary Meetings.

Wednesday evenings, at 8 o'clock :—

November 16.—Opening Address of the Chairman of Council.

November 23.—"The Systematic Promotion of British Trade." By Ben. H. Morgan.

November 30.—"The British Canal Problem." By Arthur Lee, J.P. The Right Hon. Sir Michael Hicks Beach, Bart., D.C.L., M.P., will preside.

December 7.—"The International Exhibition at St. Louis." By Walter Francis Reid, F.C.S.

December 14.—"The Patent Laws." By Chas. D. Abel.

Indian Section.

Thursday afternoons, at 4.30 o'clock :—

December 8.—"Burma." By Sir Frederic Fryer, K.C.S I.

January 19, February 16, March 16, April 6, May 11.

Colonial Section.

Tuesday afternoons at 4.30 o'clock :—

January 24, February 28, March 28, May 23.

Applied Art Section.

Tuesdays, at 4.30 or 8 o'clock :—

December 20 (8 p.m.).—"Street Architecture." By Thomas Graham Jackson, R.A.

January 31, February 21, March 21, April 11, May 16.

Papers for Meetings after Christmas :—

"The Navigation of the Nile." By Sir William H. Preece, K.C.B., F.R.S.

"The Protection of Buildings from Fire." By Killingwoth Hedges, M.Inst.C.E.

"The Present Aspect of the Fiscal Question." By Sir Charles Malcolm Kennedy, K.C.M.G., C.B.

"British Woodlands." By The Right Hon. Sir Herbert Maxwell, Bart., M.P.

"The Supply of Electricity." By James Nelson Shoolbred, B.A., M.Inst.C.E.

"Time Development in Photography, and Modern Mechanical Methods of carrying it out." By R. Child Bayley.

"Popular Jewelry." By Monsieur Lalique (Paris). (*Applied Art Section.*)

"The Cape to Cairo Railway." By Sir Charles H. T. Metcalfe, Bart., M.Inst.C.E. (*Colonial Section.*)

Cantor Lectures.

The following courses of Cantor Lectures will be delivered on Monday evenings, at 8 o'clock :—

David James Blaikley, "Musical Wind Instruments." Four Lectures (with musical illustrations).

Lecture I. — November 28. — Introduction—Music and the practical arts—Division of instruments into string, wind, and percussion—Limitation of definition—Wind instruments and the human voice—Acoustics and the art of instrument making—Vibration and wave motion—Every wind instrument a vibrating column of air—Stationary waves—Means of exciting vibration—Wave-form—Classification into brass, reed, and flute.

Lecture II.—December 5.—*Brass Instruments.*—Primitive instruments from horns and shells—Harmonic scale—Development into bugle and trumpet types—natural horns and trumpets—Introduction of slides, keys, and valves.

LECTURE III.—DECEMBER 12.—*Reed Instruments.*—Single and double reeds—Conical and cylindrical tubes—Bagpipes—Shawms, oboes, and bassoons—Clarionets—Saxophones.

LECTURE IV.—DECEMBER 19.—*Flutes.*—Modern limitation of the name—Action of the air-reed—Recorders and flageolets—Cone and cylinder flutes.

JAMES P. MAGINNIS, Assoc.M.Inst.C.E., M.Inst.Mech.E., "Reservoir, Fountain, and Stylographic Pens." Three Lectures.

January 23, 30, February 6.

DUGALD CLERK, "Internal Combustion Engines." Four Lectures.

February 13, 20, 27, March 6.

HENRY LAWS WEBB, "Telephony." Four Lectures.

March 13, 20, 27, April 3.

ALAN S. COLE, C.B., "Some Aspects of Ancient and Modern Embroidery." Two Lectures.

May 1, 8.

HENRY WILLOCK RAVENSHAW, Assoc. M.Inst.C.E., Mem.Fed.Inst.Min.Eng., "The Uses of Electricity in Mines." Two Lectures.

May 15, 22.

JUVENILE LECTURES.

Two lectures suitable for a juvenile audience will be delivered on Wednesday evenings, January 4 and 11, 1905, at Five o'clock, by Mr. CARMICHAEL THOMAS, Treasurer of the Society, on "The Production of an Illustrated Newspaper."

SECTIONAL COMMITTEES.

COLONIAL SECTION COMMITTEE.

The following is the list of the Colonial Section Committee as appointed by the Council:—

Sir William Abney, K.C.B., D.C.L., D.Sc., F.R.S. (Chairman of the Council).
Sir Westby B. Perceval, K.C.M.G. (Chairman of the Committee).
Earl of Aberdeen, G.C.M.G.
Lord Belhaven and Stenton.
Sir James Blyth, Bart.
Lord Brassey, K.C.B.
Sir Thomas Fowell Buxton, Bart., G.C.M.G.
Hon. Sir John A. Cockburn, K.C.M.G.
H. Bertram Cox, C.B.
Edward Dent.
Rt. Hon. Sir Charles Wentworth Dilke, Bart., M.P.
Hon. Alfred Dobson, Agent-General for Tasmania.
Hon. Sir Charles W. Fremantle, K.C.B.
Hon. Thomas E. Fuller, C.M.G., Agent-General for the Cape of Good Hope.
Sir Robert Giffen, K.C.B., LL.D., F.R.S.
Right Hon. Sir George Goldie, K.C.M.G., D.C.L., LL.D.
J. G. Gordon.
Henry Allerdale Grainger, Agent-General for South Australia.
Robert Kaye Gray.
Major-General Sir William Henry Rhodes Green, K.C.S.I., C.B.
W. L. Griffith.
Sir John J. Grinlinton.
Sir Charles Augustus Hartley, K.C.M.G., M.Inst.C.E.
Hon. Sir Robert G. W. Herbert, G.C.B., D.C.L., LL.D.
Sir Clement Lloyd Hill, K.C.M.G., C.B.
Sir Alfred L. Jones, K.C.M.G.
Sir Charles Malcolm Kennedy, K.C.M.G., C.B.
Hon. Henry Bruce Lefroy, Agent-General for Western Australia.
Sir Nevile Lubbock, K.C.M.G., Chairman of the West India Committee.
Charles Prestwood Lucas, C.B.
Admiral Sir Erasmus Ommanney, K.C.B., F.R.S.
Sir Montagu F. Ommanney, K.C.M.G.
Sir E. Montague Nelson, K.C.M.G.
Sir Gilbert Parker, M.P.
Sir Walter Peace, K.C.M.G.
Hon. W. Pember Reeves, Agent-General for New Zealand.
Right Hon. Sir Joseph West Ridgeway, G.C.M.G., K.C.B., K.C.I.E.
Hon. Matthew White Ridley, M.P.
Alexander Siemens.
Sir John Smalman Smith, M.A.
Earl of Stamford.
Lord Strathcona and Mount Royal, G.C.M.G., LL.D., High Commissioner for the Dominion of Canada.
Sir Thomas Sutherland, G.C.M.G.
Hon. J. W. Taverner, Agent-General for Victoria.
Hon. Sir David Tennant, K.C.M.G.
Carmichael Thomas.
Hon. Sir Horace Tozer, K.C.M.G., Agent-General for Queensland.
Sir Charles Rivers Wilson, G.C.M.G., C.B.
Sir John Wolfe-Barry, K.C.B., F.R.S.
Sir Frederick Young, K.C.M.G.
S. Digby (Secretary).

PRIZES FOR DESIGNS FOR FURNITURE.

The Council of the Society of Arts hold a sum of £400, the balance of the subscriptions to the Owen Jones Memorial Fund, presented to them by the Memorial Committee, on condition of their spending the interest thereof in prizes to "Students of the Schools of Art who, in annual competition, produce the best designs for Household Furniture, Carpets, Wallpapers, and Hangings, Damasks, Chintzes &c., regulated by the principals laid down by Owen Jones."

The prizes will be awarded on the results of the annual competition of the Board of Education, South Kensington. Competing designs must be marked "In competition for the Owen Jones Prizes."

No candidate who has gained one of the above prizes can again take part in the competition.

The next award will be made in 1905, when six prizes are offered for competition, each prize to consist of a bound copy of Owen Jones's "Principles of Design," and the Society's Bronze Medal.

Proceedings of the Society.

THE MAJOLICA AND GLAZED EARTHENWARE OF TUSCANY.

By Prof. R. Langton Douglas, M.A.

Lecture III.—Delivered May 9th, 1904.

Cafaggiolo and the later History of Ceramics in Tuscany.

"We believe," writes Professor Malagola, "that the place Cafaggiolo is destined to disappear for ever from ceramic history." "We are convinced," writes his friend Professor Argnani, "that the *fabbrica* of Cafaggiolo of Tuscany has had its origin and its existence only in the minds of certain authors by reason of a kind of mono-mania."

These two learned writers asserted that the pieces signed "In Chafaggiolo" were really made not at the castle in the Mugello, but at an imaginary *fabbrica* at Faenza styled Casa or Ca' Fagioli. It is worthy of remark that this last theory was not originated by Professor Malagola, and that its true author, the late Dr. Frati, lived to deride it. I have often heard my kind old friend now lost to us laugh over this fantasy of his earlier days, and condemn the parochial patriotism of those Faventine historians who clung to it after it was discredited. *Campanilismo*—parochial patriotism—has been responsible for three-quarters of the fatuous theories that disfigure the pages of Italian works relating to history, art, and archæology. *Campanilismo* led the Sienese writers of the 17th century to maintain that Sodoma was born not at Vercelli in Piedmont, but at Vergelle, a little Tuscan village. It led Tuscan writers of the 19th century to contend that Niccolò Pisano was born not in Apulia, but in Puglia, a little village near Lucca. It impelled Neapolitans to assert that the lovely altar-piece, "S. Louis crowning King Robert," in their church of S. Lorenzo was not the work of Simone Martini, of Siena, but of some visionary Simone Napoletano. It led the Florentines to post-date the career of Duccio of Siena, and to give one of his greatest works to Cimabue, and to assert that Ugolino and Simone Martini were pupils of Giotto. But amongst all these manifestations there has been nothing to equal the performances of the Faventine writers on majolica, who have declared that the great and ancient Sienese pottery was a late-born child of Faenza, and that Cafaggiolo was the Mrs. Harris of ceramics. With the assistance of my friend, the Cavaliere Alessandro Lisini, I have been able to do something to restore Siena to her proper place in the history of the art. It is to the credit of the late Gaetano Milanesi and Gaetano Guasti that Cafaggiolo has been given its rightful position amongst the *fabbriche* of Central Italy.

In this lecture I will tell the true story of the pottery of Cafaggiolo, as it is revealed to us in the documents discovered by the two distinguished scholars to whom I have just referred, in the signed productions of the *fabbrica*, and in the pieces which considerations of style have led me to regard as being the work of the artists who made these signed pieces. And first I will say something about the artistic parent of Cafaggiolo, Montelupo.

In a gorge of the Arno valley, between Florence and Empoli, stands tower-crowned Montelupo, guarding the high road from the capital to its sea-port. Montelupo was in all probability a very early centre of the manufacture of majolica. Already in the year 1426 Bartolomeo di Simone of Montelupo practised the art in Florence, under the patronage of the Medici, and at the close of the century the greater part of the inhabitants of the castle of Montelupo were potters. In the statutes of the Guild, dated May 3, 1510, we find the names of no less than thirty-four master-potters. Potters of Montelupo practised their art in Florence, Rome, Pisa, and Cafaggiolo. In the same manner, in the 16th century, artists from Faenza found their way to Montelupo.

The most important family of artists that took their origin from Montelupo was that of the Fattorini. We first find mention of this family in a document of the year 1469, from which we learn that Filippo di Rimiteri (or Demetrius) was practising the art of the potter in Montelupo. This Philip was a native of Zagabria in Croatia, where he first saw the light in 1403. He had two sons —Piero, born in 1445, and Stefano, born in 1458—both of whom practised their father's art. Philip died in the eighth decade of the 15th century; for in the year 1480 Piero appears as head of the family of the Fattorini, who, under the patronage of Lorenzo di Pierfrancesco de' Medici and Pierfrancesco, his son, became the founders of the pottery of Cafaggiolo.

Lorenzo di Pierfrancesco de' Medici belonged to the junior branch of the house of

Medici. He was grandson of Lorenzo, the brother of Cosimo the elder, *Pater Patriæ*. Lorenzo the Magnificent was jealous of his cousins, and, for safety, they took refuge at the court of Charles VIII., of France, not returning until Piero, Lorenzo the Magnificent's son, was chased from Florence in 1494. Lorenzo di Pierfrancesco was a man of liberal views, a poet, and a connoisseur. Elected one of the members of the body of twenty reformers who set to work to re-model the Florentine constitution under the guidance of Girolamo Savonarola, he became suspected by the popular party, who imagined that he wished to make himself lord of the city. Aware of this, Lorenzo retired to his country house at Cafaggiolo in the Mugello.

The earliest records of the Medici villa of Cafaggiolo date from the year 1427, when Averardo di Francesco de' Medici describes himself as possessing a fortress there. Averardo left the villa to his brother, Giuliano, from whence it passed to Giuliano's son, Francesco. Francesco dying without issue, Cafaggiolo came into the possession of Cosimo the Elder and his brother Lorenzo, who held it conjointly. In the end, the descendants of this Lorenzo the Elder became the sole proprietors. For, in the year 1485, his grand-nephew, Lorenzo the Magnificent, being in pecuniary difficulties, and owing large sums to his cousins, ceded to them all his rights in Cafaggiolo. Thus Lorenzo and Giovanni, grandsons of Lorenzo the Elder, became the sole owners of Cafaggiolo; and it was to this place that the younger Lorenzo's son removed the *fabbrica* of the Fattorini which his father had established in Florence.

It was about the year 1491 that Lorenzo di Pierfrancesco summoned the Fattorini from Montelupo. Already in 1480, Piero di Michele, the maternal uncle of Piero and Stefano Fattorini, had been in the service of Lorenzo di Pierfrancesco Medici. It is probable that when Lorenzo di Pierfrancesco de' Medici began to interest himself in the art of majolica, and to entertain the idea of establishing a *fabbrica* in Florence, this Piero di Michele recommended to his master his nephews at Montelupo. In that year he wrote a letter to a friend of his in Siena, a letter which is still in existence,* exhorting him to send him to Florence some of the fine white earth used by the Sienese potters.

The pottery Lorenzo founded in Florence was soon transferred to Montelupo. A document of the year 1504 states that Piero and Stefano Fattorini were at that date at Cafaggiolo engaged in the manufacture of majolica. Piero died a few years after the transference of the pottery to the Mugello, and Stefano, the younger brother, carried it on with the help of his nephew Filippo. Ultimately certain of Stefano's own sons also adopted their father's occupation. As late as 1568 three of them, Jacopo, Domenico, and Michele were carrying on the pottery, and at the end of the century descendants of the Fattorini were still making majolica at Cafaggiolo.

In its later days Cafaggiolo witnessed tragedies and scenes of passion. Here on July 11, 1576, Piero de' Medici assassinated his unfaithful wife Eleonora of Toledo, stabbing her as she stood before a looking-glass in her dressing-room. Nine years later, Piero's brother, the Duke Francesco and Bianca Capello tarried here. And whilst these episodes were being enacted in the great villa, under its shadow the later Fattorini practised their art, now trying to please the ill-fated Eleonora, now the beautiful Bianca.

Such is the documentary evidence in reference to the *fabbrica* of Cafaggiolo. It proves (1) that there was an important pottery at this castle in the Mugello, (2) that it was a private *fabbrica* of the Medici, (3) that the artists who worked at Cafaggiolo were the Fattorini of Montelupo, (4) that the pottery was not in existence there until some date in the closing years of the 15th century, or the early years of the 16th.

We will now turn to the evidence of signatures and marks. There are two marks, twice found in conjunction, which, without question, belong to Cafaggiolo. The first of these is the name of the place itself. The second a mark consisting of a "P." crossed by an "F," or of a monogram consisting of "P. F. S." On a plate reported by Dr. Giuseppe Maria Brocchi in a book describing the province of the Mugello, written in 1748, he mentions a plate which bore the monogram P. F. S. and the inscription "*Fato adi primo di Fraio nl* 1544 *i gafagiuollo.*" A plate bearing the same monogram and the words "*In Chafagguolo*" is reported by Signor Guasti. On several plates we find one of these marks, either the signature "*in Chafaguollo*" or "*in Gafagiolo*" or the monogram "F. P. S." On others we find earlier forms of the monogram. We find a "P." crossed by "F."

* "Carteggio Mediceo avanti il Principato," Filza 124, ac. 263. Quoted in full in Guasti, "Cafaggiolo, e di Altre Fabbriche di Ceramiche in Toscana." Florence: Barbèra, 1902; pp. 68, 69.

and a "P." alone. All these signatures are easy of explanation. The "P." alone stands for Pietro Fattorini; the "P. F." also for Pietro Fattorini; the "F. P. S." for Stefano di Pietro Fattorini, or for Stefano di Pietro di Filippo.

There are various signatures in which the word "*Cafaggiolo*" occurs in some form. In a plate in Mr. Salting's collection bearing a representation of Judith with the head of Holofernes, is an inscription which is variously read as "*fato in Chafaguolo*" and "*Jap° in Chafagguolo.*"

Let us examine the pieces bearing these marks and discover what they reveal as to the quality and characteristics of the wares of Cafaggiolo. First of all we will look at a very remarkable and interesting plate which represents a young artist decorating a plate with two of his patrons looking on.

The painter, with bent head and holding the brush in his right hand, is painting a plate which is held in his left hand and rests on his arm which is supported by his left knee. On a small table by the artist's side are six low pots containing colours with brushes laid across them. Two newly finished pieces of majolica are on a stone table in the foreground. The two young patrons looking on are probably a betrothed pair, who are watching the decoration of some of the artistic objects intended for their future home. The lady and her lover are seated on the same bench. She holds an aromatic ball in her left hand, which is on her knee. In her right hand is a handkerchief. The lover watches the artist intently. This plate bears the monogram "P. F. S." It perhaps represents, as Signor Guasti suggests, Stefano di Pietro Fattorini painting the wedding service of Pierfrancesco de' Medici and Maria Soderini. The marriage took place in the year 1511.

Another important plate of the same *fabbrica*, a piece of great historical interest, is the "Piatto di Pompa," bearing a representation of the procession of Leo X. The Pope, "seated in a rich chair or throne, on a platform or palanquin, borne on men's shoulders, is carried in procession accompanied by cardinals riding on mules, and a numerous retinue of ecclesiastics, officials, and guards. In the foreground, marching at the side of the main procession, is a regiment of halberdiers in parti-coloured costume, headed by a drummer and fifer, and an officer bearing a banner charged with the 'palle' of the Medici family; the main procession is headed by a cavalier riding on an elephant richly caparisoned. Immediately behind the Pope appears a column of pikemen with an ensign at their head, also bearing the banner of the Medici family. The Pope is represented in the act of benediction; he wears the papal tiara and a rich cope of diapered cloth of gold fastened by a large circular morse or fibula. In his left hand he holds an object which resembles an orb or ball of crystal; the fingers of both hands are covered with numerous rings. The composition contains upwards of fifty figures, executed in colours on a dark blue background. The figure of the Pope has every appearance of being an authentic portrait, and the heads of several of the cardinals and attendants have marked individuality of expression. Amongst the followers is a Turk, with red hair and a long beard, and wearing a high-crowned turban. The reverse of the piece has concentric lines in blue, and is signed with a large P."

This piece is probably one of a set that was given to Leo X. by his cousin, Pierfrancesco di Lorenzo, on the occasion of his coronation in 1513. We know, at any rate, from documentary evidence, that Pierfrancesco, whose father had not been on good terms with the Pope's brother, Piero de' Medici, paid a special visit to Rome to assist at the ceremonies connected with the coronation of the Medici Pope. It was during this visit to Rome that Lorenzino, Pierfrancesco's son, and the murderer of Alessandro de' Medici, first saw the light. Probably Pierfrancesco took with him specimens of the one art that was practised under the shadow of his country house, and under his immediate patronage. The letter "P" on the back of this plate is the mark of Pietro Fattorini. I cannot, therefore, concur in Signor Guasti's supposition that Pietro died in the year 1507.

If we examine these plates, and others with a similar signature, we find that the glaze is of fine quality, white and clear. The manner in which the colour blue is applied is very characteristic. It is a rich deep cobalt, and is much used, especially in backgrounds, where it is put on rather thickly and streakily, and is often very dark indeed. We also find a clear yellow and a brilliant opaque orange. Another characteristic colour is an opaque Indian red. In these pieces the outlines are often somewhat strong and pronounced, and the drawing vigorous, but, like the colour, something wanting in subtlety.

An important work of Stefano Fattorini is the plate on which is a representation of "St. George" after Donatello's statue formerly at Or San Michele and now at the Museo Nazionale in Florence. The figure differs somewhat from its original. The saint is clad in armour. Over his left shoulder is tied a yellow cloak, which falls to the ground behind the right foot. With his left hand he supports the shield in front of him, his right grasps a dagger, and a sword is by his side.

This plate has all the qualities of the *fabbrica*. It is vigorous in design, strong and decided in drawing and modelling, and has a streaky dark-blue background of cobalt.

Works of a different class to those I have mentioned were also made in Cafaggiolo. In the Salting collection there is a plate which, did it not bear the signature "*In Chafaguolo*" we would attribute to Siena. It is a plate *a porcellan*, and on it we find a similar design to that on the border of Maestro Benedetto of Siena's signed plate at South Kensington which is also *a porcellan*, and on other pieces found in Siena. I am now able to show by documentary evidence that this kind of design was not adopted in Cafaggiolo until several years after Maestro Benedetto's plate was painted, In a letter written by Jacopo, the Medici steward at Cafaggiolo, to Francesco da Empoli, Pierfrancesco de' Medici's representative in Florence, he asks whether he wishes for pieces with heraldic or other decorations, and whether he wishes for white pieces adorned with blue flowers, that is, majolica, "a porcelan come s'usano." This document proves that by the year 1522 the design which had been used in Siena had become popular in *fabbriche* "come s'usano."

Two smaller temporary *fabbriche* dependent upon Cafaggiolo were those of Gagliano and Monte. In the cases of these potteries the campanilismo of Professors Malagola and Argnani led them into lamentable error. Having invented a Casa or Ca' Faggioli in Faenza, they had to find a pottery of Monte in their native city, as the plate in the Cluny Museum that bears the inscription "*fato in monte*" so closely resembles those of Cafaggiolo. Professor Malagola discovered that, as is natural, a street of Faenza was called "Monte," and he concluded that these pieces were made in that street. Thus the manufacturing of imaginary Faventine potteries went on merrily, before the archivists stepped in and at one blow knocked down all these card houses.

Gagliano was a fortress of the ancient family of Ubaldini, not far from Cafaggiolo, and near it was their villa of Monte. A number of the Fattorini were summoned from Cafaggiolo to work here. A plate recently preserved in this same villa of Monte bore on the back the Fattorini monogram with a "G" beside it, and underneath the inscription "*A Gagliano fatto* 1552." On a plate in the Fortnum collection in the Ashmolean Museum at Oxford is a plate bearing a representation of Mucius Scaevola in the act of burning his hand on the brazier. On the back of it is also to be seen the mark of the Fattorini with a "*G.*" by the side of it, and the inscription "*in gagliano nell* . . . . 1547." Below the inscription are the letters "*A. F.*"

Of the plate in the Cluny Museum which was made at Monte, it is only necessary to say that the inscription on the back is decorated with tridents; and the trident is one of the marks of the Fattorini.

In the later history of ceramics in Tuscany we can define three important periods:—Firstly, the period of the Medici porcelain which followed immediately upon or rather overlapped in part the great age of majolica; secondly, the period of the Campani at Siena, and of the *fabbriche* of S. Quirico and Cetinale, private potteries of the Chigi family; and thirdly, the current period of Ginori and Cantagalli. Of these the most important, though by far the least productive, is the first. It is not possible to claim for Tuscany precedence in the manufacture of porcelain. The true porcelain was known in Florence in the middle of the fifteenth century. Niccolò Niccoli probably had in his collection fine examples of Eastern wares. Vespasiano da Bisticci, the Florentine bookseller, says that Niccolò's table was full of pieces of porcelain. And although the word *porcellana* was very loosely applied, it seems, in the quattrocento and the cinquecento, the context leads us to believe that it is the real porcelain that is here referred to. Certainly the beautiful vases of porcelain sent to Lorenzo de' Medici in 1487 by the Sultan of Egypt were of the harder, more transparent ware. The ingenuity of the Florentines did not enable them, however, to fathom the secret of the manufacture of porcelain. It was a Venetian, a certain Leonardo Peringer, who made the discovery. We read in a Venetian document of the year 1518 that this Leonardo had discovered a new process not heretofore known in the renowned city of Venice for

making every sort of porcelain transparent like those of the East.

Under Alfonso II. the manufacture of porcelain was carried on at Ferrara in the latter half of the 16th century at the same period that the art began to be practised in Florence. Already in the year 1557, a correspondent of Cosimo I. Pietro Gelido, writing frcm Venice, had referred to the new discovery and especially to the materials used in making porcelain. The exact date when the Medici initiated the manufacture of porcelain in Florence is not known. Camillo of Castel Durante, who made porcelain for the Duke of Ferrara, was known to Francesco de' Medici, and was probably in Florence in the year 1567. A letter of Matteo di Cavallari of Faenza, written in 1569, shows that for some time the Medici had interested themselves in the new wares. In that year, also, a young artist skilled in the manufacture of porcelain came to Siena with a letter from Orazio Fontana. This young man may or may not have been Flaminio Fontana. At any rate, between 1573 and 1578 Flaminio was making porcelain in Florence at the Casino di San Marco. In the following decade, a native of Faenza, Pier Maria, called the "Faentino delle Porcellane," made porcelain in Florence under the patronage of Francesco de' Medici. In the Casino di San Marco, in those Medici gardens where the young Michelangelo had worked, the Duke had his manufactory of porcelain. He himself dabbled in alchemy and in mineralogy, and he was vain enough to encourage the belief that the pieces of porcelain he presented to princes and nobles were of his own making. The products of this *fabbrica* are generally marked with a representation of Brunelleschi's cupola with the letter "*F.*" underneath. Sometimes, however, we find the six pills of the Medici with the ducal crown above them, and one letter of the initials "*F. M. M.*" placed on each of the three uppermost balls. At Sèvres is a piece marked with the cupola bearing the date 1481. This is most probably a work of Pier Maria, the Faentino. Another dated piece known to Foresi was of the year 1505. A pottery of porcelain was still in existence in the year 1620.

Of the Medici porcelain we find two distinct classes of wares. In the first the style of the decoration is purely Italian. The pieces of this class are marked with the Medici balls and the initials "*F.M.M.E.D.II.—Franciscus Medici, Magnus Etruriæ Dux Secundus.*" The other and more common class is adorned with Oriental patterns and is frankly imitative of Eastern wares. These pieces are marked with the cupola of Brunelleschi. In all there are, I believe, only between thirty and forty genuine pieces of Medici porcelain in existence.

The second of the later periods of importance in the history of Tuscan ceramics is the period of Ferdinand Maria Campani. Campani flourished in Siena in the first half of the 18th century. He took several of his designs from Raphael. His drawing is good and his colour not unpleasing. There are more than a dozen of his pieces at South Kensington, some of which are signed and dated. The earliest date is the year 1730, the latest 1747. In the same period artistic wares were being made in the *fabbriche* of the Chigi at San Quirico d'Orcia and Cetinale in the neighbourhood of Siena.*

The third important period in the later history of ceramics is that in which we live. The *fabbriche* of Ginori and Cantagalli, as far as modern industrial conditions permit, maintain the prestige of Tuscany amongst the lovers of ceramics. The manufactory of Ginori was founded by the Marchese Carlo of that noble house 170 years ago, in the year 1735. He established it at Doccia between five and six miles from Florence. The first artistic pieces were produced in the year 1740. At that time the Marchese Carlo engaged the services of a Viennese chemist, a Florentine sculptor, and a foreign painter of the name of Anreiter. But it was not till the year 1848, when the Marchese Lorenzo became proprietor, that the pottery began to be of very great importance. A chemist and a connoisseur, educated in Paris and understanding well the best processes in vogue in foreign pot-

* Since delivering this lecture I have been enabled to study the documentary evidence relating to these *fabbriche* in the Chigi Archives at Siena, as well as almost all of the important existing pieces of S. Quirico and Cetinale. Such a complete study would have been impossible, had I not received constant, generous assistance from that fine connoisseur, the Marchese Chigi-Zondadari. I intend shortly to publish the results of my researches. Here I can but state as briefly as possible a few of the more important facts about the history of the *fabbrica* of S. Quirico and the character of its wares. The *fabbrica* was founded in October, 1693. The first *vasaio* was a certain Mariano Sticcoli, who came from Castiglioncello Bandini, near S. Giovanni d'Asso. He was followed by a succession of master potters, of whom the most important was Bartolommeo Terchi. The *fabbrica* ceased to exist about the middle of the 18th century. The best wares of the *fabbrica* have a rich white glaze. Some of them are decorated with designs imitated from, or suggested by, designs on the majolica of Savona. The master-potters of the *fabbrica* employed various marks. Some of the best pieces bear the Chigi arms and the initials "S. Q."

teries, he succeeded in making the Ginori manufactory one of the largest and best managed potteries in the world. He was a humanitarian, as well as a man of science, an artist and a great organizer. He took the deepest interest in the welfare of his workpeople, in the education of their children, in their amusements. The manufactory now employs 1,400 hands, and its wares are held in high estimation throughout Europe.

The Cantagalli pottery is well known to all visitors to Florence. For more than five centuries members of the family have been in some way connected with the manufacture of earthenware; but it was not until the year 1878 that Giuseppe Cantagalli began the manufacture of artistic wares. This house has principally devoted itself to copying the works of the Della Robbia and the plates and vessels of the great age of artistic majolica. Its best imitations reach a high standard of excellence, and are well adapted for use in provincial museums and art schools where it is impossible to procure many costly original pieces. In artistic tiles the Cantagalli have produced some good original works. It is to be hoped that a period of more or less successful imitation will be followed by a period of artistic creation.

Miscellaneous.

*THE COTTON CRISIS.**

It is evident that during the last four years the consumption of cotton has been rapidly overtaking production, and at the present time many mills in England, the United States, and the Continent are running short time, entailing privations on the operatives and a wastage of employers' capital.

Two principal causes have contributed to this shortage. The first is a want of elasticity in the American crop, which amounted to $11\frac{1}{4}$ million bales in 1889, since which date it has averaged $10\frac{1}{2}$ million bales. The second cause is the large increase in the world's consumption, viz., about 400,000 to 500,000 bales per annum.

Although short time has been worked all over the world, the English spinners have suffered most. A certain amount of short time was worked in 1901 and 1902. In 1903 most of the Lancashire mills worked forty hours instead of fifty-five and a half for four months. In 1904, forty hours was worked from January to August with the exception of a few weeks, when the time was extended to forty-eight hours.

* Paper by J. A. Hutton, read before Section F of the British Association.

The crisis has been aggravated by the manipulations of speculators, who forced cotton up from $5\frac{3}{4}$d. to 6d. a pound. These manipulations have been accompanied by violent fluctuations, which have made legitimate business exceedingly difficult, if not impossible.

The principal remedy adopted so far is short time. It is not generally realised what a very costly remedy this is. The operatives suffer severely through decreased wages, the manufacturers' expenses are nearly as large, and in only a moderately sized mill running short time would make a difference of £100 a week, or £5,000 per annum. The kindred trades, such as dyers, printers, finishers, and distribution must also suffer. There is also a decreased demand for the productions of other trades less closely connected. The receipts of the Lancashire and Yorkshire Railway Company for the first six months of 1904 show a falling off of £44,000 as compared with 1903, and £70,000 as compared with 1902. In fact the result is widespread throughout the country. It is estimated that no less than 10,000,000 people are more or less dependent on the cotton trade. Mr. C. W. Macara estimates the loss to capital and labour in the cotton and allied trades through short time at £150,000 per week.

There is no great hope of immediate relief. The evil would be mitigated if the market were free from the manipulations of speculators. Legislative measures have been suggested, but would be difficult to devise without doing more harm than good. Owing to labour and other difficulties there is little probability of the American crop increasing over 12,000,000 bales in the immediate future, so that large sources of supply must be found in other parts of the world to meet the normal increase in demand, estimated at 400,000 bales per annum. The solution of this problem is the *raison d'être* of the British Cotton-growing Association and similar bodies in France, Germany, and elsewhere.

The British Cotton-growing Association was inaugurated on June 12, 1902. A large amount of experimental work has been carried on, and it has now been decided to utilise the results of these experiments, and to extend the work on a commercial basis.

The work of the Association is confined to the British Empire. In India, in conjunction with the Government, efforts are being made to improve the methods of cultivation, so as to increase the quantity grown and to improve the quality. Seed farms should be established for educational purposes, and to supply selected seed for native cultivators. These should be nearly self-supporting. Seed and machinery have been sent to the West Indies, and financial assistance has been given. Large quantities of Sea Island cotton, ranging in value from 11d. to 16d. a pound, have been grown, and there is every hope of a large cultivation being established. In Egypt proper the Government and people are fully alive to the advisability of increasing the growth. In British East Africa and British Central Africa there is an

excellent prospect, and the work is well advanced in the latter colony, and 3,000 bales of Egyptian cotton will be marketed this season. In British West Africa there is a large area—500,000 square miles—and a large population — 10,000,000. Cotton equal to average American has been grown in large quantities, and there is no reason why the whole of West Africa —British and foreign—should not at some future date grow 20,000,000 bales of cotton. Seed has been supplied, experts have been sent out, and seed farms are being established. It is felt that the best policy is to establish cotton-growing as a native industry, as the climate is unsuitable for Europeans. The British Cotton-growing Association have undertaken an enormous task, and have proved that sufficient cotton for Lancashire's needs can be grown in British possessions. Their work, if successful, will enrich the colonies and increase the demand for manufactured goods.

*ANALYSIS OF THE SOIL BY MEANS OF THE PLANT.**

In view of the many difficulties attaching to the interpretation of soil analyses as a guide to the manurial requirements of the soil, attempts have been made from time to time to use the living plant as an analytical agent. It is well known that while the ash of a given plant possesses a characteristic composition, variation of constituents like the potash or phosphoric acid will take place to a certain extent in response to the manuring. Investigations on the utility of the analysis of plant ashes to ascertain the needs of the soil for specific mineral manures have been undertaken by Heinrich, Helmkamf, and others, and particularly by Atterberg, who used oats as his test plant.

To try the agreement between this method and analysis of the soil, further experiments were begun in 1902 with oats grown in pots containing six soils of very different types. Although in certain striking cases both methods agreed in their results, there was no strict measure of consistency between the two sets of figures, while the variation between the material grown in duplicate pots of the same soil were often greater than that between different soils.

For further information the data accumulated in the Rothampsted experiments were consulted, and analyses of wheat, barley, mangels, and potatoes from certain of the plots were compared with the analyses of the soil of the same plots. In dealing with cereals it is necessary to examine the whole plant, the composition of the grain fluctuates but little with the manuring; any deficiency of a particular constituent will result in less grain being formed, while any excess will be left behind in the straw. From these Rothamsted results it seemed that though the composition of the plant did reflect that of the soil, yet the range of variation shown by the plant was less than that indicated by soil analysis. The ash of the root crops showed, however, a wider range of variation, and, in view of the greater sensitiveness of root crops to the lack of mineral plant foods as compared with the comparative indifference of the cereals, they seemed likely to prove better test plants to indicate the need or otherwise of specific mineral manures. Samples of potatoes, mangels, and of swedes were obtained during 1903 from experimental plots in various parts of the country, where the field trials indicated a reaction to phosphoric acid or potash manuring; analyses of the ash were made and compared with the analyses of the soil. The results indicate that the analysis of the ash of the Swede plant would often provide a better indication of the phosphoric acid requirements of the soil than does the analysis of the soil itself, and that similarly the mangel plant will serve to test the state of the soil as to potash. A great number of data as to the limits of normal variation in the composition of the ash are, however, wanted before the method can be employed for practically testing the soil.

* Abstract of a paper by A. D. Hall, M.A., read before Section K of the British Association at Cambridge.

Notes on Books.

SCIENCE AND PRACTICE OF PHOTOGRAPHY. Fourth edition. By Chapman Jones, F.I.C., &c. London: Iliffe and Sons. 1904.

About twelve or fourteen years ago Mr. Chapman Jones published, under the above title, a manual of photography which has ever since been well appreciated by scientific students of the art. Two fresh editions of the book have since been issued, the last of them in 1895. Since that year much has been done in photography, many new discoveries have been made, there has been considerable advance in knowledge, considerable change in practice. A measure of this progress is afforded by a comparison between the two editions of the book. Roughly, there appears to be some thirty per cent. more matter, and while the third edition contains 55 chapters, the new one contains 68. Many of the additional chapters or large parts of them, appear to have no equivalent in the earlier editions. For instance, the following subjects, all now treated at length, are either not dealt with at all, or are very briefly touched upon in the original works. New organic developers, Illumination of the dark room, Time development, Neutral and Acid developers, Nature of the developable image, Printing on P.O.P., Methods of measurement, Various methods of pigment printing (of the gum-bichromate class, &c.).

At the same time it is hardly fair to estimate the value of the book by the amount of additional matter it contains. Too often the re-issue of a scientific manual is only a bit of patchwork, it may be be very skilfully done, but done in a manner obvious enough to the expert. This is often a source of annoyance

caused by finding bits of obsolete description left in the midst of fresh material, or by lighting on incongruously novel matter introduced into a mass of ancient record with the idea of bringing all up to date.

Whatever be the merits or demerits of the present work, it is no piece of patchwork. A perusal of certainly the greater part of the book—candour forbids the assumption on the part of the reviewer that he has read the whole—justifies the statement that the book is for all practical purposes a new one, and it certainly gives the impression that it has been practically re-written.

It covers in comprehensive fashion the whole practice of modern photography, and the reputation of the author may be accepted as sufficient guarantee for the accuracy and the trustworthy character of his work.

JAPANESE COLOUR PRINTS. By Edward F. Strange. London: H.M.'s Stationery Office.

This is one of the valuable series of illustrated art handbooks published for the Victoria and Albert Museum. In 1897, Mr. Strange wrote his first book on this subject, "Japanese Illustrations." Since that date he has obtained much additional information on the subject, and the present handbook is the result. The subjects of the successive chapters are—the Torii school; the period of Haronobu; Utamaru, Yeishi aud Yeizan; the Utagawas; Hokusai; the Osaka group; the pupils of Kunisada and Kuniyoshi; Landscape; Surimono.

The art of wood-carving in Japan dates back to a remote period, and it was very general in the seventh and eighth centuries. Prints were often coloured by hand, and the earliest use of colour-printing at present known is in a series of patterns of *kimono* (the outer robe worn by women), dated 1667. Of these patterns, the author writes:—"These are printed in at least four colours, only one of which is used on each plate, namely, black, olive green, red, and blue. Of course, as these colours are used singly, it cannot be claimed that the result is colour printing in the ordinary sense of the term. But the mere employment of coloured ink is a step of great importance, from which the full achievement was a natural and easy development."

In order to help the student, a table of Japanese chronology, and of the signatures of artists are added. The book is fully illustrated by eighty-four plates reproduced from the large collection of Japanese prints in the Art Library; one of these represents a woman making coloured prints.

ACROSS THE GREAT SAINT BERNARD: the Modes of Nature and the Manners of Man. By A. R. Sennett. London: Bemrose and Sons.

Mr. Sennett here recounts his travels on the bicycle in Switzerland, ending with the pass of the Great St. Bernard and his visit to the famous Hospice. The book is well illustrated, and the author attempts to interest his readers in the causes that go to form the marvellous architecture of Nature, and the origin of the wondrous colouring to be found on all sides among the Alps. He also deals with the mountain industries of the laborious Swiss, such as the watch trade, and the manufacture of musical-boxes. Appendixes are added, which deal with glaciers and their motion, disappearing lakes, caves, stalactites and stalagmites, ice and regelation, sculpturing by frost and water, reflections in water, clouds and the rainbow, &c.

Obituary.

CHRISTOPHER JAMES LITTLE.—Mr. Little, who had been a member of the Society of Arts since 1880, died at 17, Groombridge-road, South Hackney, N.E., on the 9th of September. Mr. Little was well known for his claims to have been the inventor of the block system of signalling on railways, and for some time he carried on a rather vigorous controversy in the Technical Press in support of his claims. Those who are curious in such matters will find the question fully discussed in the correspondence columns of the *Engineer* for 1891. The precise rights and wrongs of a somewhat vexed question need not now be discussed, but it is certain that Mr. Little never received the credit to which he considered himself entitled for the early suggestion of a system now of universal application. He served his apprenticeship as an engineer in the Great Western Railway Works at Swindon, and subsequently became an inspector of engines and boilers.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, Nov. 7...Engineers, in the Theatre of the United Service Institution, Whitehall, S.W., 7½ p.m. Mr. James Thame, "Recent Developments in Crushing and Concentrating Machines."

Chemical Industry (London Section), Burlington-house, W., 8 p.m. Mr. J. Fletcher Moulton, "The Trend of Invention in Chemical Industry."

British Architects, 9 Conduit-street, W., 8 p.m. Opening Address by the President, Mr. John Belcher.

London Institution, Finsbury-circus, E.C., 5 p.m. Sir Robert Douglas, "The Present Condition and the probable Future of China."

TUESDAY, Nov. 8...Civil Engineers, 25, Great George-street, S.W., 8 p.m. 1. Mr. Alfred Edward Carey, "Coast Erosion." 2. Mr. Ernest Romney Matthews, "Erosion on the Holderness Coast of Yorkshire."

Colonial Inst., Whitehall-rooms, Whitehall-place, S.W., 8 p.m. Dr. G. R. Parkin, "The Rhodes Scholarships."

THURSDAY, Nov. 10—London Institution, Finsbury-circus, E.C., 6 p.m. Sir A. C. Mackenzie, "Liszt."

Electrical Engineers, 25, Great George-street, S.W., 8 p m. Inaugural Address by the President, Mr. Alexander Siemens.

FRIDAY, Nov. 11...Architectural Association, 18, Tuftin-street, S.W.. 7½ p.m. Mr. W. Henman, "Ventilation."

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FRIDAY, NOVEMBER 11, 1904.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

ARRANGEMENTS FOR THE SESSION.

The First Meeting of the One Hundred-and Fifty-First Session will be held on Wednesday evening, the 16th of November, when an Address will be delivered by SIR WILLIAM ABNEY, K.C.B., D.C.L., D.Sc., F.R.S., Vice-President and Chairman of the Council.

Previous to Christmas there will be Five Ordinary Meetings, one meeting of the Indian Section, and one of the Applied Art Section. The following arrangements have been made:—

ORDINARY MEETINGS.

Wednesday evenings, at 8 o'clock:—

NOVEMBER 16.—Opening Address of the Chairman of Council.

NOVEMBER 23.—"The Systematic Promotion of British Trade." By BEN. H. MORGAN.

NOVEMBER 30.—"The British Canal Problem." By ARTHUR LEE, J.P. The RIGHT HON. SIR MICHAEL HICKS BEACH, Bart., D.C.L., M.P., will preside.

DECEMBER 7.—"The International Exhibition at St. Louis." By WALTER FRANCIS REID, F.C.S.

DECEMBER 14.—"The Patent Laws." By CHAS. D. ABEL.

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock:—

DECEMBER 8.—"Burma." By SIR FREDERIC FRYER, K.C.S.I. The RIGHT HON. the EARL of HARDWICKE, Under-Secretary of State for India, will preside.

January 19, February 16, March 16, April 6, May 11.

COLONIAL SECTION.

Tuesday afternoons at 4.30 o'clock:—

January 24, February 28, March 28, May 23.

APPLIED ART SECTION.

Tuesdays, at 4.30 or 8 o'clock:—

DECEMBER 20 (8 p.m.).—"Street Architecture." By THOMAS GRAHAM JACKSON, R.A.

January 31, February 21, March 21, April 11, May 16.

Papers for Meetings after Christmas:—

"The Navigation of the Nile." By SIR WILLIAM H. PREECE, K.C.B., F.R.S.

"The Protection of Buildings from Fire." By KILLINGWOTH HEDGES, M.Inst.C.E.

"The Present Aspect of the Fiscal Question." By SIR CHARLES MALCOLM KENNEDY, K.C.M.G., C.B.

"British Woodlands." By The RIGHT HON. SIR HERBERT MAXWELL, Bart., M.P.

"The Supply of Electricity." By JAMES NELSON SHOOLBRED, B.A., M.Inst.C.E.

"Time Development in Photography, and Modern Mechanical Methods of carrying it out." By R. CHILD BAYLEY.

"Popular Jewelry." By MONSIEUR LALIQUE (Paris). (*Applied Art Section.*)

"The Cape to Cairo Railway." By SIR CHARLES H. T. METCALFE, Bart., M.Inst.C.E. (*Colonial Section.*)

CANTOR LECTURES.

The following courses of Cantor Lectures will be delivered on Monday evenings, at 8 o'clock:—

DAVID JAMES BLAIKLEY, "Musical Wind Instruments." Four Lectures (with musical illustrations).

LECTURE I.—NOVEMBER 28.—Introduction—Music and the practical arts—Division of instruments into string, wind, and percussion—Limitation of definition—Wind instruments and the human voice—Acoustics and the art of instrument making—Vibration and wave motion—Every wind instrument a vibrating column of air—Stationary waves—Means of exciting vibration—Wave-form—Classification into brass, reed, and flute.

LECTURE II.—DECEMBER 5.—*Brass Instruments.*—Primitive instruments from horns and shells—Harmonic scale—Development into bugle and trumpet types—natural horns and trumpets—Introduction of slides, keys, and valves.

LECTURE III.—DECEMBER 12.—*Reed Instruments.* —Single and double reeds—Conical and cylindrical tubes—Bagpipes—Shawms, oboes, and bassoons—Clarionets—Saxophones.

LECTURE IV.—DECEMBER 19.—*Flutes.*—Modern limitation of the name—Action of the air-reed—Recorders and flageolets—Cone and cylinder flutes.

JAMES P. MAGINNIS, Assoc.M.Inst.C.E., M.Inst.Mech.E., "Reservoir, Fountain, and Stylographic Pens." Three Lectures.

January 23, 30, February 6.

DUGALD CLERK, "Internal Combustion Engines." Four Lectures.

February 13, 20, 27, March 6.

HENRY LAWS WEBB, "Telephony." Four Lectures.

March 13, 20, 27, April 3.

ALAN S. COLE, C.B., "Some Aspects of Ancient and Modern Embroidery." Two Lectures.

May 1, 8.

HENRY WILLOCK RAVENSHAW, Assoc. M.Inst.C.E., Mem.Fed.Inst.Min.Eng., "The Uses of Electricity in Mines." Two Lectures.

May 15, 22.

JUVENILE LECTURES.

Two lectures suitable for a juvenile audience will be delivered on Wednesday evenings, January 4 and 11, 1905, at Five o'clock, by Mr. CARMICHAEL THOMAS, Treasurer of the Society, on "The Production of an Illustrated Newspaper."

APPLIED ART SECTION COMMITTEE.

A meeting of the committee of the Applied Art Section was held on Tuesday afternoon, 8th inst. Present: Sir George Birdwood, K.C.I.E., C.S.I., in the chair; Cyril Davenport, Lewis F. Day, Gerald C. Horsley, A. Lasenby Liberty, Halsey Ricardo, Alexander Siemens, H. H. Statham, Carmichael Thomas, with Sir Henry Trueman Wood, Secretary of the Society, and Henry B. Wheatley, Secretary of the Section. The arrangements for the new session were considered.

ST. LOUIS EXHIBITION.

LIST OF AWARDS TO MEMBERS OF THE SOCIETY OF ARTS.

The following is a list of the awards made at the St. Louis Exhibition to members of the Society of Arts, and to firms of which a partner or representative is a member of the Society:—

Sir W. de W. Abney, K.C.B., F.R.S., Grand Prize.

Aitchison and Co. (James Aitchison), Silver Medal.

Joseph Baker and Sons (G. S. Baker), Grand Prize and Silver Medal.

F. P. Bhumgara and Co. (J. S. Bhumgara), three Grand Prizes, three Gold, three Silver, and two Bronze Medals.

Boake, Roberts and Co. (A. Boake), Grand Prize, two Gold Medals, and one Silver Medal.

Bennett H. Brough, Gold Medal.

Brunner, Mond and Co. (Sir John Brunner, Dr. Ludwig Mond), Gold Medal.

Burroughs, Wellcome and Co. (Henry S. Wellcome), three Grand Prizes and three Gold Medals.

Alfred Campion, Silver Medal.

H. C. H. Carpenter, Bronze Medal.

Walter Carson and Sons (H. J. Dyer), Silver Medal.

Spencer Chapman and Messel (Spencer Chapman), Gold Medal.

Cedric Chivers, Gold Medal.

S. Cowper Coles and Co. (S. H. Cowper Coles), Gold Medal and Silver Medal.

Crompton and Co. (Lt.-Col. R. E. B. Crompton, C.B.), Gold Medal.

Lewis F. Day, Silver Medal.

Sir James Dewar, F.R.S., Gold Medal.

Doulton and Co. (H. Lewis Doulton), Two Grand Prizes.

J. C. and J. Field (Frederick A. Field), Grand Prize.

Henry Fleuss, Bronze Medal.

Frederick Hollyer, Gold Medal.

Herbert W. Hughes, Silver Medal.

India Rubber, Gutta Percha, and Telegraph Works Co. (Robert Kaye Gray), Gold Medal.

Lord Kelvin, Grand Prize.

Kelvin and James White, Ltd. (Lord Kelvin), Gold Medal.

Liberty and Co. (J. Lasenby Liberty), Grand Prize.

J. Mansergh and Sons (J. Mansergh), Grand Prize.

Dr. Ludwig Mond, F.R.S., Gold Medal.

Mond Nickel Co. (Dr. Ludwig Mond), Silver Medal.

Nobel's Explosives Co. (C. O. Lundholme, David Corrie), Grand Prize.

Pulsometer Engineering Co. (Henry Fleuss), Silver Medal.

J. E. Stead, F.R.S., Gold Medal.

Sutton and Sons (Leonard Sutton), Grand Prize and Gold Medal.

Sir J. W. Swan, F.R.S., Silver Medal.

Townson and Mercer (F. M. Mercer), Gold Medal.
Wellcome Chemical Research Laboratories (Henry S. Wellcome), Grand Prize and Gold Medal.

If any name has been inadvertently omitted from this list the Secretary requests that he may be informed of the award so that correction may be made.

BARBADOS BANANAS.

The fact that very large consignments of bananas from Jamaica and Costa Rica have recently arrived in this country, has drawn attention, not only to the increased favour in which this fruit is now held by all classes in the British Isles, but also to the capabilities of its very much further extension, with the view of supplying a wholesome and nutritious fruit at a cheap rate at times when home-grown fruits are not available. Though large quantities of bananas come to us from our own colony of Jamaica, it must not be forgotten that other countries contribute very extensively to the general imports, and it would seem that a good opportunity has now occurred for pushing forward the cultivation in, and the exportation from, other British colonies.

In connection with this it does not appear to be generally known that Barbados has already taken the matter in hand and is now cultivating and exporting a fine quality of fruit, the history of which is as follows :—

As is well known, for many years past the staple product of this island has been sugar, but this crop has for a long period been an unprofitable one, and more remunerative crops have been sought. In 1902 shipments of Barbados potatoes, which are perhaps better known as sweet potatoes, were made under the instructions of Sir Daniel Morris, K.C.M.G., the Imperial Commissioner of Agriculture for the West Indies, but in spite of every effort being made to introduce them to public favour, they were not generally appreciated, and the attempt ended in failure ; while, however, shipping the potatoes, a few bunches of bananas were sent as an experiment, and were found on arrival to be of splendid quality and flavour, although in bad condition, owing to faulty packing and handling. After some experimenting this trouble was overcome, and small consignments were sent, which arrived in perfect condition. The consignments were then considerably increased, but the results were still unsatisfactory, for although it was comparatively easy to bring a few crates, the case was quite different when a large number were shipped at one time ; the temperature of the holds of the steamers became very high, owing to the fact that the fruit when ripening always generates a certain amount of heat. For this reason, several consignments arrived with about 90 per cent. of the fruit rotten. However, on the strong advice of Sir Daniel Morris, the shipments were continued, and eventually, by the installation of a proper system of ventilation on the Royal Mail steamers, complete success has been attained, so that the fruit now received in bad condition does not exceed 1 per cent., and that is usually the result of inexperience in shipping.

From the first no attempt has been made to compete with the Jamaica banana industry, the fruit grown in Barbados being a different kind from that shipped from Jamaica, which is a large-fruited variety known as the "Gros Michael." It grows on plants fourteen or fifteen feet high, and is capable of being roughly handled without any appreciable damage. The Barbados banana is the same variety as that grown in the Canary Islands and Madeira, and is known as the dwarf or Chinese variety. Its height does not exceed ten or twelve feet, but the bunches are, as a rule, large and heavy and the fruit of good size ; the flavour is decidedly superior to the fruit either from the Canary Islands or Madeira, which is probably due to the richer nature of the Barbados soil. The plants are propagated from the shoots from old roots, known as suckers, which are placed in the ground at about ten feet apart. They should be well manured if large bunches are wanted, and the plants also require a considerable amount of moisture. When the fruits are young, the bunch remains almost upright ; but as it matures, the stalk bends over under the weight of fruit, and forms a convenient "handle" for carrying.

In about eleven months from the time of planting, the bunch is ready to cut, but the exact time to do this can only be known from long experience, and this lack of experience is the usual cause of failure in starting.

The Jamaica banana can be shipped naked, and arrives in England in good condition ; but the Barbados fruit, being much more delicate, has to be packed, as it is quite impossible to ship it otherwise. On being cut, it is sometimes packed in the field, and sometimes sent to a central packing house, but wherever it is packed, it is handled with the greatest possible care, as a slight bruise or rub when the fruits are still green, in which condition the bunch is of course always shipped, would, when ripe, show a black mark which would considerably reduce its value in the English market. So great is the care given to avoid this, that the Barbados fruit arrives in England in better condition than any other kind. Many of the bunches being absolutely free from marks.

The method of packing is simple, but the packer requires considerable experience. The bunch is first wrapped in a sheet of cotton wool, which preserves it from injury and absorbs moisture, it is next wrapped in a sheet of thin paper to keep the cotton wool in place. It is then placed in a crate in which a layer of dead banana leaves, or "trash" as they are called, has been placed. The bunch is then carefully packed round with more "trash," and the top of the crate

nailed on. The crate is then marked with a certain number of crosses to denote the size of the bunch it contains, and with the distinguishing mark of the shipper.

In the Canary Islands, the fruit is generally shipped by merchants, but in Barbados a much better system is in vogue. The consignments are made by Mr. J. R. Bovell, superintendent of the Agricultural Department in Barbados, and each grower or shipper has his own mark and number, a necessary arrangement to avoid confusion. All the fruit shipped by Mr. Bovell is consigned to one firm, having very extensive stores at Plymouth and Portsmouth, and as this firm make a point of supplying it direct to shopkeepers, and not to wholesale merchants or middlemen, the amount of money wasted in useless profits is *nil*. The grower is practically in direct communication with the shopkeeper, and has only to pay the small fee for shipping from Barbados, and the expenses of distributing here. In this way, he obtains a better price for his fruit, and the shopkeeper can buy it at a lower price than would be the case if it passed through several hands, as it does in the Canary Islands. In order that the fruit may be known by a definite name, the trade mark "Dagger Brand" has been registered, and this is placed on all the crates which contain nothing but absolutely the finest fruit. Being a new industry, it has been possible to organise it on the best possible lines.

The greater part of the fruit is shipped to Plymouth, and when the Royal Mail steamer passes the Lizard her arrival is telegraphed to Plymouth; the mail tender then goes out to meet her to bring ashore the mails and passengers; at the same time several large lighters are towed out by a steam tug to bring ashore the fruit, the crates are slung out of the holds and lowered into the lighters. When the lighters are full they are covered with tarpaulins to protect the fruit, and are either towed in again or sail in, according to the state of wind and tide; they proceed into Sutton Harbour to the wharf, on which the stores are situated and to which they are transferred, where every crate is examined, and stacked according to the degree of ripeness of the contents. In order to facilitate ripening the stores are divided into several compartments, which can be heated to various temperatures. These stores are probably the largest of this kind in the country, having a floor-area of nearly a quarter of an acre. So great is the demand for the fruit that it is very rapidly sold, and at the present time the immediate neighbourhood of Plymouth takes practically all that is shipped. The imports, however, are increasing, nearly one thousand crates of these Barbados bananas having recently been landed at Plymouth from one of the Royal Mail steamers, all of which arrived in splendid condition, a result due to a great extent to good packing, but also to the fact that Barbados is the nearest to England of the West Indian islands, and the last place touched by the steamers.

This industry is the result of the labours of Sir Daniel Morris, and the other officials of the Imperial Department of Agriculture, but it could never have been properly organised without the active help of the officers of the Royal Mail Steam Packet Company, who carried all the experimental shipments free, and made considerable alterations in the ships to fit them for the traffic. The ships' officers have taken a great interest in the industry, and the splendid condition of the fruit on arrival is largely due to the skill with which they handle it. As an instance of the trouble they take it may be mentioned that the temperature of the ships' hold is examined every six hours during the voyage, and regulated as is necessary.

RUBBER CULTIVATION IN SIAM.

The cultivation of rubber in Siam has only recently been started, some thousands of plants having been set out as an experiment. These plants of the Para variety (*Hevea brasiliensis*) are said to be doing exceedingly well although very little care has been bestowed upon them, and they have been planted indiscriminately in various places and under varying conditions of moisture, sun, &c. Consul General Nash of Bangkok states that it is still too soon to tell what the ultimate result of this venture will be, but he is of opinion that it will prove highly successful; there is, however, one thing to fear, namely, the so-called disease which has developed in the Para rubber plantations of the Malay Peninsula. About this pest nothing very definite can be learned, except that it attacks the leaves and is very destructive. The most important of the rubber-producing plants indigenous to Siam is the *Ficus elastica*, so much used for ornamental purposes, and found in large quantities in the Siamese jungle and throughout India and Indo-China generally. Rubber is collected from these trees by the simple process of making longitudinal scarifications in the bark from which the coagulated milk is taken in long strips. It is said that a plant six years old will yield four pounds of rubber annually of a good quality. Another rubber-producing plant of known commercial value is a creeper of great size, probably one of the *Urceola*. It is most difficult to obtain any reliable information on the subject of these creepers from a botanical point of view, and it is quite possible that they are indigenous to Siam. These creepers yield a fair amount of rubber produced by cutting them into sections two or three feet long, and collecting the juice, which is subsequently boiled for a moment in water, and immediately coagulates into a viscous mass, which has to be dried by smoking over a fire before it can be handled. The bark is also used, and upon being pounded and boiled gives about ten per cent. of a rather inferior rubber. It is said that these creepers grow with

astonishing rapidity, and that two or three weeks after being cut down they show a growth of six or seven feet.

Obituary.

FRANK MCCLEAN, LL.D., F.R.S.—Mr. McClean, the engineer and astronomer, died at Brussels on Tuesday, 8th inst., in his 67th year. He was the only son of the late J. R. McClean, F.R.S., and was educated at Westminster, the College, Glasgow, and Trinity College, Cambridge, of which foundation he was a scholar. He graduated in 1859 as a wrangler. Adopting his father's profession, he was apprenticed in the same year to Sir John Hawkshaw, and three years later became a partner in the firm of McClean and Stileman. In this connection he was engaged in charge of important dock and railway works until 1870, when he retired from his profession, and from that time forward devoted himself in the main to solar and stellar spectroscopic work. He established an astronomical observatory at Tunbridge Wells, and from time to time published various papers on spectroscopic work. For his photographic survey of star spectra in both hemispheres and other contributions to the advancement of astronomy he was awarded the gold medal of the Royal Astronomical Society. He was the discoverer of the presence of oxygen in the helium class of stars. In 1890 Mr. McClean founded the Isaac Newton studentships at Cambridge, and in 1894 he presented the Victoria photographic telescope to the Royal Observatory, Cape of Good Hope. Mr. McClean was elected a member of the Society of Arts in 1861.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, Nov. 14...Optical, 20, Hanover-square, W., 8 p.m. Mr. W. A. Dixey, "Periscopic Lenses."

Surveyors, 12, Great George-street, S.W., 8 p.m. Opening Address by the President, Mr. H. T. Steward.

Camera Club, Charing-cross-road, W.C., $8\frac{1}{4}$ p.m.

London Institution, Finsbury-circus, E.C., 5 p.m. Mr. A. J. Herbertson, "The Relation of Occupations to Geographical Conditions."

TUESDAY Nov. 15...Statistical (at the HOUSE OF THE SOCIETY OF ARTS), John-street, Adelphi, W.C., $5\frac{1}{2}$ p.m. Inaugural Address by the President, Sir Francis Sharp Powell.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Discussion on papers: 1. Mr. Alfred Edward Carey, "Coast Erosion." 2. Mr. Ernest Romney Matthews, "Erosion on the Holderness Coast of Yorkshire."

United Service Institution, Whitehall, S.W. 3 p.m. Lt.-Col. J. A. Nunn, "Sick Horses in time of War."

Zoological, 3, Hanover-square, W., $8\frac{1}{2}$ p.m. 1. Mr. Oldfield Thomas, "Mammals from the Island of Fernando Po," collected by Mr. E. Seimund. 2. Mr. Oldfield Thomas, "*Hylochœrus*, the Forest-Pig of Central Africa." 3. Dr. P. Chalmers Mitchell, "The Species of Crowned Cranes." 4. Mr. J. Lewis Bonhope, "The Mouse-Hares of the Genus *Ochotona*."

Horticultural, Vincent-square, Westminster, S.W., 3 p.m.

WEDNESDAY, Nov. 16..SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Opening Meeting of the 151st Session. Inaugural Address by Sir William Abney, Chairman of Council.

Meteorological, 25, Great George-street, S.W., $7\frac{1}{2}$ pm. 1. Lieut. Charles Royds, R.N., "Meteorological Observing in the Antarctic." 2. Mr. Frederick J. Brodie, "Decrease of Fog in London during recent years." 3. Mr. R. L Holmes, "Hurricane in Fiji, January 21-22, 1904."

Chemical, Burlington-house, W., $5\frac{1}{2}$ p.m. 1. Messrs. R. Meldola and J. H. Lane, "The Isomerism of the Amidines of the Naphthalene Series." 2. Mr. P. C. Ray, "Theory of the Production of Mercurious Nitrite and of its Conversion into various Mercury Nitrates." 3. Mr. G. D. Lander, "Amidechloroiodides." 4. Messrs. D. T. Jones and G. Tattersall, "A New Synthesis of Isocaprolactone and some Derivatives." 5. Messrs. J. B. Cohen and J. Miller, (i) "The Influence of Substitution in the Nucleus on the Rate of Oxidation of the Side-chain." (ii.) "Oxidation of the Halogen Derivatives of Toluene." 6. Messrs. S. S. Pickles and C. Weizmann, "The Halogen Derivatives of Naphthacenequinone." 7. Mr. B. Prentice, "Constitution of Pyrazolidone Derivatives."

Microscopical, 20, Hanover-square, W., 8 p.m. Mr. A. E. Conrady, "Theories of Microscopic Vision" (a vindication of the Abbe theory).

THURSDAY, Nov. 17...Linnean, Burlington-house, W., 8 p.m. 1. The Lord Avebury, "The Structure of the Stems of Plants." 2. Mr. G. B. Buckton. "Observations on Undescribed or little known Species of Membracidæ."

London Institution, Finsbury-circus, E.C., 6 p.m. Mr. H. F. B. Lynch, "Armenia."

Camera Club, Charing-cross-road, W.C, $8\frac{1}{4}$ p.m. Mr. H. B. Wheatley, "The Tower of London."

Mining and Metallurgy, Geological Society's Rooms, Burlington-house, W., 8 p.m. 1. Discussion on the Papers by W. A. Caldecott, Charles Butters, and E. M. Hamilton, and by M. Simpkin, J. B. Ballantine, and W. Fischer Wilkinson. 2. Mr. Ernest A. Weinberg, "The Blake-Morscher Electro-Static Separator." 3. Mr. E. D. McDermott, "The Baltic Mill, Lake Superior." 4. Mr. H. E. Nicholls, "A Method of Testing Alluvial Deposits."

FRIDAY, Nov. 18...United Service Institution, Whitehall, S.W., 3 p.m. Major-General Sir A. Tulloch, "Coaling Stations and their Garrisons."

North-East Coast Institute of Engineers and Shipbuilders, Newcastle-on-Tyne, $7\frac{1}{2}$ p.m.

Mechanical Engineers, Storey's-gate, Westminster, S.W., 8 p.m. Messrs. A. E. Seaton and A. Jude, "Impact Tests on the Wrought Steels of Commerce."

CONTRIBUTIONS TO THE READING-ROOM.

The Council have to acknowledge, with thanks to the Proprietors, the receipt of Transactions of Societies and other Periodicals.

TRANSACTIONS, &c.

Aeronautical Society, Journal.
African Society, Journal.
American Academy of Arts and Sciences, Proceedings.
American Chemical Society, Journal.
American Institute of Architects, Bulletin.
American Institute of Electrical Engineers, Transactions.
American Institute of Mining Engineers, Transactions.
American Philosophical Society, Proceedings and Transactions.
American Society of Civil Engineers, Proceedings.
American Society of Mechanical Engineers, Transactions.
Architectural Association, Notes.
Association of Engineering Societies (American), Journal.
Australasian Association for the Advancement of Science, Report.
Bath and West of England Society, Journal.
British Association for the Advancement of Science, Report.
British Dental Association, Journal.
British Fire Prevention Committee, Publications.
British Horological Institute, Horological Journal.
Brussels, Société d'Etudes Coloniales, Bulletin.
———, Travaux Publics de Belgique, Annales.
Camera Club, Journal.
Canada, Royal Society, Proceedings and Transactions.
Canadian Institute, Transactions.
Canadian Patent Office, Record.
Canadian Society of Civil Engineers, Transactions.
Central Chamber of Agriculture, Proceedings.
Ceylon, Planters' Association, Year Book.
Chemical Society, Journal.
Chicago, Western Society of Engineers, Journal.
———, Field Columbian Museum, Publications.
Civil and Mechanical Engineers' Society, Transactions.
Cleveland Institution of Engineers, Proceedings.
Cold Storage and Ice Association, Proceedings.
Cornell University, Physical Review.
East India Association, Journal.
Farmers' Club, Journal.
Franklin Institute, Journal.
Geneva, Société des Arts, Bulletin de la Classe d'Industrie et de Commerce.
Geological Society, Quarterly Journal.
Glasgow Philosophical Society, Proceedings.
Haarlem, Koloniaal Museum, Bulletin.
Imperial Department of Agriculture for the West Indies, Publications.
India, Geological Survey, Memoirs, and Palæontologia Indica.
India, Government of, Agricultural Ledger.
Indian Meteorological Department, Memoirs.
Institute of Bankers, Journal.
Institute of Chemistry, Proceedings.
Institution of Civil Engineers, Minutes of Proceedings.
Institution of Civil Engineers of Ireland, Transactions.
Institution of Electrical Engineers, Journal.
Institution of Engineers and Shipbuilders in Scotland, Transactions.
Institution of Gas Engineers, Transactions.
Institution of Mechanical Engineers, Proceedings.
Institution of Mining and Metallurgy, Transactions.
Institution of Naval Architects, Transactions.
Iron and Steel Institute, Journal.
Japan, College of Science, Imperial University, Journal.
Japan Society, Transactions and Proceedings.
Junior Institution of Engineers, Record of Transactions.
Kew Gardens Bulletin.
Linnæan Society, Journal.
Liverpool Engineering Society, Transactions.
Liverpool Literary and Philosophical Society, Proceedings.
London Chamber of Commerce, Journal.
Manchester Literary and Philosophical Society, Memoirs and Proceedings.
Manchester Steam Users' Association, Reports.
Munich, Polytechnische - Verein - Bayerisches Industrie-und-Gewerbeblatt.
National Association for the Promotion of Technical and Secondary Education, "Record."
National Indian Association, "The Indian Magazine and Review."
National Service League, Journal.
New South Wales, Royal Society, Journal and Proceedings.
New York Academy of Sciences, Annals and Memoirs.
North-East Coast Institution of Engineers and Shipbuilders, Transactions.
Nova Scotian Institute of Science, Transactions.
Odontological Society, Transactions.
Paris, Comité International des Poids et Mesures, Procès Verbaux.
——, Conservatoire National des Arts et Métiers, Annales.
——, Société d'Encouragement pour l'Industrie Nationale, Bulletin.
——, Société de Geographie Commerciale, Bulletin.]

Paris, Société Internationale des Electriciens, Bulletin.
——, Société Nationale d'Acclimatation de France, Bulletin.
Patent Agents, Chartered Institute of, Transactions.
Patent-office, Illustrated Official Journal.
Pennsylvania (Western), Engineers' Society of, Proceedings.
Pharmaceutical Society, The Pharmaceutical Journal.
Philadelphia, Academy of Natural Sciences, Proceedings.
————, Engineers' Club, Proceedings.
Physical Society, Proceedings.
Quekett Microscopical Club, Journal.
Rome, Associazione Elettrotecnica Italiana, Atti.
Royal Agricultural Society, Journal.
Royal Asiatic Society, Journal.
Royal Astronomical Society, Memoirs.
Royal Colonial Institute, Proceedings.
Royal Cornwall Polytechnic Society, Annual Report
Royal Geographical Society, "The Geographica Journal."
Royal Horticultural Society, Journal.
Royal Institute of British Architects, Journal.
Royal Institution of Cornwall, Journal.
Royal Institution of Great Britain, Proceedings.
Royal Irish Academy, Transactions and Proceedings.
Royal Meteorological Society, Quarterly Journal and Record.
Royal National Life Boat Institution, "The Life Boat" and Annual Report.
Royal Photographic Society of Great Britain, "The Photographic Journal."
Royal Scottish Society of Arts, Transactions.
Royal Society, Philosophical Transactions and Proceedings.
Royal Society of Edinburgh, Transactions and Proceedings.
Royal Statistical Society, Journal.
Royal United Service Institution, Journal.
Sanitary Institute, Journal.
Smithsonian Institution, Report and Publications.
Society of Antiquaries, Archæologia and Proceedings.
Society of Biblical Archæology, Proceedings.
Society of Chemical Industry, Journal.
Society of Dyers and Colourists, Journal.
Society of Engineers, Transactions.
Society of Public Analysts, "The Analyst."
South Wales Institute of Engineers, Proceedings.
Victoria Institute, Journal of the Transactions.
Wisconsin Academy of Sciences, Transactions.

JOURNALS.

Weekly.

Amateur Photographer.
American Architect and Building News.
American Gas Light Journal.
American Machinist.
Architect.
Athenæum.
Automobile Club Journal.
Automotor.
Board of Trade Journal.
Bradstreet's.
British Architect.
British Journal of Photography.
Builder.
Building News.
Chemical News.
Chemist and Druggist.
Colliery Guardian.
Cosmos: Revue des Sciences.
Draper.
Economist.
Electrical Engineer.
Electrical Review.
Electrical Times.
Electrician.
Electricity.
Engineer.
Engineering.
Engineering News (New York).
Engineering Record (New York).
Engineering Times.
English Mechanic.
Gardeners' Chronicle.
Gardening World.
Iron and Coal Trades Review.
Ironmonger.
Journal of Gas Lighting.
Lancet.
Land and Water.
Mechanical Engineer.
Medical Press and Circular.
Millers' Gazette.
Mining Journal.
Moniteur Industriel.
Musical Standard.
Nature.
Notes and Queries.
Page's Weekly.
Photographic News.
Photography.
Practical Engineer.
Produce Markets' Review.
Public Health Engineer.
Publishers' Circular.
Queen.
Railway Times.
Review of the River Plate.
Revue Industrielle.
Sanitary Record.
Saturday Review.
Science.
Scientific American.
Shipping World
Spectator.
Surveyor.
Textile Mercury

Fortnightly.

Agricultural News (Barbados).
Corps Gras Industriels.
Country Brewers' Gazette.
Finance Chronicle.
Irish Builder.
Jeweller and Metalworker.
Madrid Cientifico.
Perak Government Gazette.
Quinzaine Coloniale.
Railways (Calcutta).
Woodworker.

Monthly.

American Exporter (New York).
Architectural Review.
Arms and Explosives.
Bookseller.
Brewers' Guardian.
Brewers' Journal.
British Trade Journal.
Building Societies' Gazette.
Cabinet Maker and Art Furnisher.
Caterer and Refreshment Contractors' Gazette.
Coach Builders' and Wheelwrights' Art Journal.
Cold Storage and Ice Trades Review.
Dyer and Calico Printer.
Educational Times.
Electrical Magazine.
Electro Chemist and Metallurgist.
Engineering Magazine (New York).
Engineering Press, Monthly Index Review.
Engineering Review.
Estate Magazine.
Foundry Trade Journal.
Giornale del Genio Civile (Rome).
Ice and Cold Storage.
Indian and Eastern Engineer.
Indian Review (Madras).
Industries (Durban).
International Sugar Journal.
Investors Monthly Manual.
Irish Technical Journal.
Irish Textile Journal.
Iron and Steel Magazine (Boston, U.S.A.)
Journal d'Agriculture Tropicale.
Journal d'Hygiène.
Labour Co-partnership.
Leather Trades' Review.
Machinery Market.
Marine Engineer.
Mercantile Guardian.
Miller.
Mois Scientifique et Industriel.
Moniteur Scientifique.
Music.
Musical Times.
Oestereichische Monatsschrift für den Orient.
Oils, Colours, and Drysalteries.
Paper Makers' Monthly Journal.
Paper Making.
Philosophical Magazine.
Piano Journal.
Plumber and Decorator.
Pottery Gazette.
Process Photogram.
Propriété Industrielle (Berne).
Railway Engineer.
Revue du Travail (Brussels).
Revue Mineralurgique.
Saddlers, Harness Makers, and Carriage Builders Gazette.
Science Abstracts.
Symons's Meteorological Magazine.
Textile Manufacturer.
Textile Recorder.
Textile World Record (Boston).
Watchmaker, Jeweller, and Silversmith.
Water.

Quarterly.

Climate.
Edinburgh Review.
Quarterly Review.
Transvaal Agricultural Journal.
West Indian Bulletin.

NEWSPAPERS.

African Review.
Banbury Advertiser.
Bombay Gazette (Overland Summary).
British Australasian.
Cape Times (Weekly Edition).
Ceylon Observer (Overland Edition).
Englishman (Calcutta).
Hindu (Madras).
Home and Colonial Mail.
London Commercial Record.
London and China Telegraph.
Madras Weekly Mail.
Newcastle Weekly Chronicle.
Nottinghamshire Guardian.
Pioneer Mail (Allahabad).
Shipping Gazette and Lloyd's List (Weekly Summary).
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